FRIDAY, JUNE 21, 1901.

CONTENTS

Practical Tonnage Rating.*

BY GEORGE R. HENDERSON.

In 1898 the writer was chairman of a committee which reported to this Association on the subject of Tonnage Rating for locomotives. In this report it was stated that the committee believed that results could generally be secured more quickly and satisfactorily by first producing the theoretical rating and checking this up by practical tests. How far the theoretical rating will be satisfactory depends upon the care and foresight used in determining it. The committee above referred to presented a number of diagrams and formulae for use in such work, but when there is much of this to be done the calculations of the various cases require a great deal of time, particularly when momentum grades and many sizes of locomotives must be considered. In fact, the writer remembers a case several years back when it occupied a force of six men for ten days to rate thirteen classes of engines over 1,500 miles of road, and this without considering momentum grades. With 5,000 miles of track and 75 varieties of locomotives, the former methods would be almost prohibitive, and this has led to the adoption of new methods by which an ordinary division of say 500 miles can be rated in from three to five hours, and for all the locomotives in service, the rating to be practically correct for momentum grades as well as "dead pulls." Empties and "time freights" may also be included with no extra labor, and thus a new division, heretofore unoperated, may be scheduled before the equipment is placed upon it. Of course, there will always be cases where an increase in the speed of approach to a grade will permit a heavier rating, but it is a very easy matter to make slight variations in the schedule.

Those who have attempted to establish ratings by means of actual tests upon the road know the many difficulties encountered and how seldom results can be satisfactorily duplicated. Variations in the weather or the steaming of the engine, the condition of the track and the train, and often the unexpected display of a danger signal throw so many obstacles in the way of successful tests that the "office method" is by many considered preferable. The writer believes that by the use of the following rules and diagrams it will be possible to rate almost any modern engine on any profile and alignment, and with very few calculations to establish a satisfactory schedule.

Tractive Force of Locomotives.

The tractive force referred to in this article will be that available at the circumference of the drivers, and will be designated by T, and is determined as follows:

At slow speeds, 5 to 8 miles an hour, with the reverse lever in the corner notch and a cut-off of about 90 per cent. of the stroke, pressures will be obtained about as follows:

Initial pressure	= .95 boiler pressure.
Mean effective pressure	= .91 initial pressure.
Mean effective pressure	= .86 boiler pressure.
Allowing 8 per cent. internal friction	= .92 M.E.P.
Mean available pressure	= .80 boiler pressure.

This allows for friction of pistons, valves, eccentrics, etc., but not the resistance to motion which must be considered with the train. For the maximum available tractive force we have for single expansion engines:

$$T = \frac{p\,d^2\,s}{D} \quad \dots\dots (1)$$

Where p = mean available pressure in lbs. per sq. in.
d = diameter of cylinder in inches.
s = stroke in inches.
D = diameter of driver in inches.

We can also write:

$$T = \frac{.8\,P\,d^2\,s}{D} \quad \dots\dots (2)$$

Where P = working boiler pressure in lbs. per sq. in.

For 2-cylinder compounds, when operating compound:

$$T = \frac{.8\,P\,d_l^2\,s}{D\,(r+1)} \quad \dots\dots (3)$$

Where d_l = diameter of low-pressure cylinder in inches, r = ratio of cylinder volumes.

For 2-cylinder compounds when operating simple:

$$T = \frac{.8\,P\,d_h^2\,s}{D} \quad \dots\dots (4)$$

Where d_h = diameter of high-pressure cylinder in inches. (This, of course, assumes that the adhesion of the engine is sufficient to allow it to develop this tractive force without slipping.)

Four-cylinder compounds will give values as follows:

When operating compound:

$$T = \frac{1.6\,P\,d_l^2\,s}{D\,(r+1)} \quad \dots\dots (5)$$

And when operating simple:

$$T = \frac{1.6\,P\,d_h^2\,s}{D} \quad \dots\dots (6)$$

While variations in these figures may sometimes be looked for they will generally represent safe deductions at the slow speed mentioned above.

As the speed is increased the value of T will evidently be reduced, as the boiler is generally inadequate to maintain full pressure with the lever in the corner over 5 to 8 miles per hour. In order to determine the possibilities in this direction tests were made with a dynamometer car and also by means of the Chicago & Northwestern Testing Plant, the standard 10-wheel freight engine of that road being taken for this purpose. This locomotive has the following proportions:

Cylinders (single)	20 by 26 in.
Driving wheel diameter	63 in.
Steam pressure	190 lbs.
Tube-heating surface	2,146 sq. ft.
Fire-box heating surface	186 sq. ft.
Total heating surface	2,332 sq. ft.
Grate area	29 sq. ft.
Total cylinder volume	9.5 cu. ft.
Ratio of grate area to cylinder volume	3
Ratio of heating surface to cylinder volume	245
Ratio heating surface to grate area	80
Weight on drivers	118,350 lbs.
Weight of engine and tender	130 tons
T (max.)	25,000 lbs.

Diagram No. 1 shows the relative tractive force at different speeds. The curve illustrates the results derived from records obtained on the "testing plant" and the crosses are plotted from the dynamometer car experiments. Thus it will be seen that the test plant gave generally the maximum T, as might be expected. In order to simplify the calculations, it is more convenient to consider the average T during the period of retardation, and the right-hand curve on diagram No. 1 gives the average T during a reduction from the speed designated by the abscissa to 5 miles per hour. The two curves on diagram No. 1 therefore present a ready means of obtaining the tractive force for a fixed or variable speed. (Of course, a large increase in the proportions of boiler to cylinder will give curves having greater ordinates for the corresponding abscissa than those shown, which are based on the class R engines as stated above.)

Resistance of Train.

Diagram No. 2 gives the curves for train resistance in accordance with the *Engineering News* and the Baldwin Locomotive Works formulae, being respectively = $2 + \frac{V}{4}$ and $3 + \frac{V}{6}$, where V equals velocity in miles per hour, and the shaded portion or zone shows the variation in resistance that may be met with. (In this diagram, the abscissae represent the unit of grade, speed, etc., and the ordinates the resistance.) For grades we have resistance = .38 M when M = the feet rise per mile.

Curves give a resistance equal 0.7 c, where c = degree of curvature. Acceleration (and retardation) a resistance = $0.0132\,A^2$ when A = speed attained in one mile, in miles per hour. (The latter includes rotative energy of the wheels and axles. The "average speed" curve is used for varying speeds and gives the average resistance between the selected speed and five miles per hour.

Effect of Momentum.

By utilizing the momentum of retardation we are enabled to pull much heavier trains up a grade than we could with a dead pull only. The effect of this is to produce a virtual grade, which is less steep than the actual grade, and the weight of train which can be pulled corresponds to this virtual grade. It must be remembered, however, as illustrated in Diagram No. 1, that at high speed the tractive force of the engine is reduced, and when we desire to figure momentum grades we must calculate on the average available tractive force during the change of speed from that at the foot of the hill to, say, five miles per hour at the top. The relation of this to the maximum T can be found from the right-hand curve of Diagram No. 1.

The average resistance to speed may be taken from Diagram No. 2 and the resistance due to actual grade from the same chart. This resistance, however, is to be reduced by the amount of inertia due to retardation of train from the maximum speed to five miles per hour. The average force of inertia in lbs. per ton may be expressed approximately by the formula, $70\,\frac{V^2 - 25}{x}$, where

V = initial velocity in miles per hour.
x = distance traversed during retardation in feet.

Diagram No. 3 gives a series of these curves for various values of V and x when speed is reduced to five miles per hour. This energy added to the average T represents the propelling force, and the sum of the various

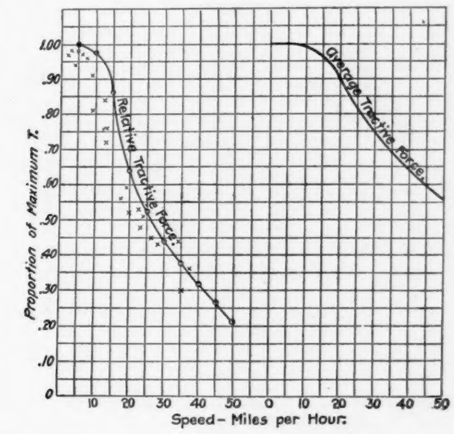


Diagram No. 1.

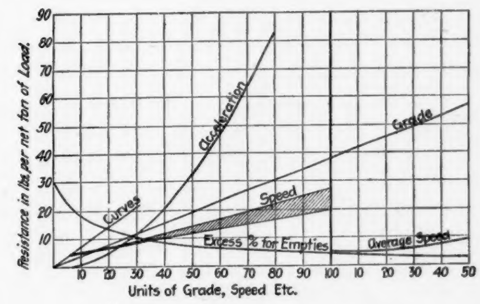


Diagram No. 2—Train Resistance.

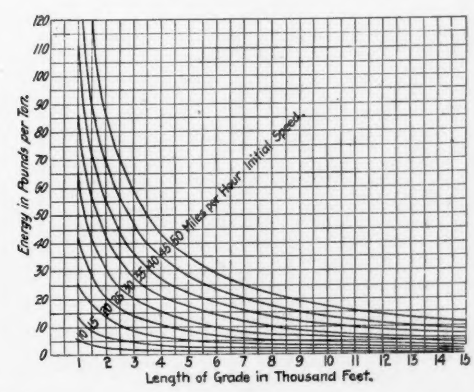


Diagram No. 3—Energy of Retardation to Five Miles Per Hour.

resistances gives the amount to be overcome by the first two forces. The equation must, of course, be made for the total weight of train multiplied by the various coefficients in lbs. per ton, as the tractive force is also in lbs.; as, for example, to find the weight of train, divide the average tractive force by the sum of the coefficients for grade and average speed minus the coefficient for energy due to retardation. The weight of the engine and tender must be deducted for net loading.

Effect of Empty Cars.

It has been suggested from results of experiments that an empty car has about 1.8 lbs. greater resistance per ton than a loaded car at slow speeds. If we wish to express this as a percentage of increase over loaded trains we can use the formula for this excess $\frac{1.8}{y + .}$, where y = resistance due to grade. The locus of the formula is drawn on Diagram No. 2 where the ordinate gives the excess resistance in per cent. for empties on the grade in feet per mile represented by the abscissa. Thus empty trains should be considered as having so many per cent. greater tonnage than actually the case, depending upon the grade to be ascended.

Method of Rating Engines.

The various rules enumerated above are embodied in Diagrams Nos. 4, 5 and 6, which give the tons behind

*A paper presented at the Saratoga Convention of the Master Mechanics' Association.

tender which a Class R engine can pull on various grades. The heavy line gives the rating on a dead pull for grades of the ascent shown by the abscissa. The line marked "empties" gives the rating for empty cars.

In Diagram No. 4 the upper fine lines give the load

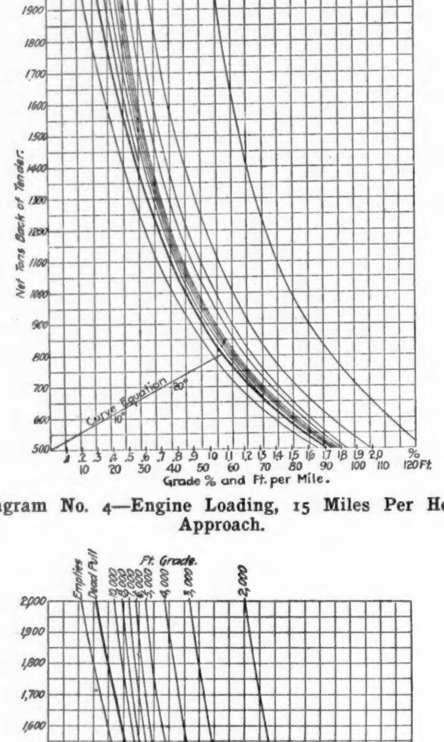


Diagram No. 4—Engine Loading, 15 Miles Per Hour, Approach.

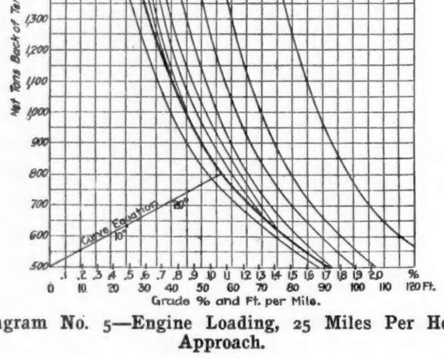


Diagram No. 5—Engine Loading, 25 Miles Per Hour, Approach.

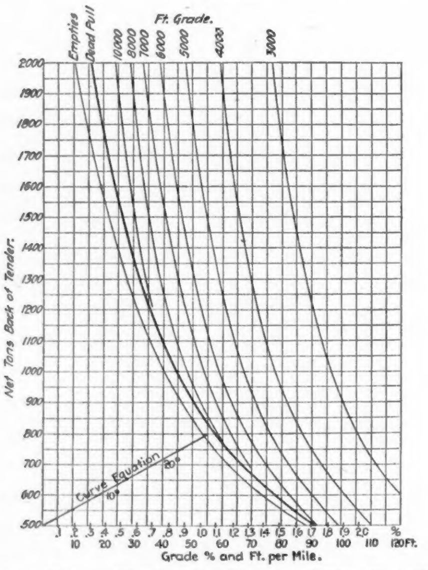


Diagram No. 6—Engine Loading, 35 Miles Per Hour, Approach.

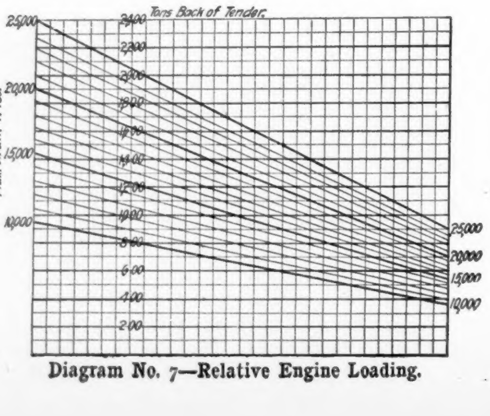
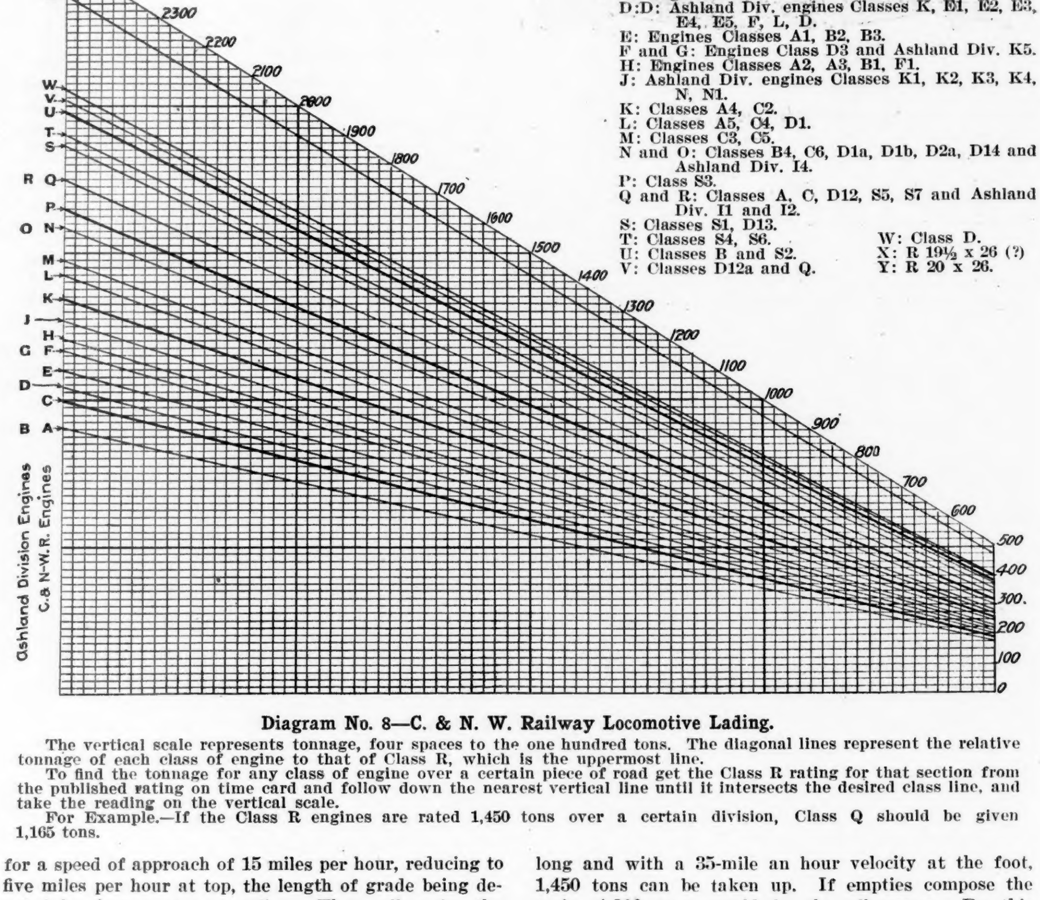


Diagram No. 7—Relative Engine Loading.



References to Letters at Right of Diagram.

A and B: Engines Classes F2, H1, H3 and Ashland Div. A.
C: Engines Classes B5, E1, E4, E5, H4.
D:D: Ashland Div. engines Classes K, E1, E2, E3, E4, E5, F, L, D.
E: Engines Classes A1, B2, B3.
F and G: Engines Class D3 and Ashland Div. K5.
H: Engines Classes A2, A3, B1, F1.
J: Ashland Div. engines Classes K1, K2, K3, K4, N, N1.
K: Classes A4, C2.
L: Classes A5, C4, D1.
M: Classes C3, C5.
N and O: Classes B4, C6, D1a, D1b, D2a, D14 and Ashland Div. I4.
P: Class S3.
Q and R: Classes A, C, D12, S5, S7 and Ashland Div. I1 and I2.
S: Classes S1, D13.
T: Classes S4, S6.
U: Classes B and S2.
V: Classes D12a and Q.
W: Class D.
X: R 19½ x 26 (?)
Y: R 20 x 26.

Diagram No. 8—C. & N. W. Railway Locomotive Lading.

The vertical scale represents tonnage, four spaces to the one hundred tons. The diagonal lines represent the relative tonnage of each class of engine to that of Class R, which is the uppermost line.

To find the tonnage for any class of engine over a certain piece of road get the Class R rating for that section from the published rating on time card and follow down the nearest vertical line until it intersects the desired class line, and take the reading on the vertical scale.

For Example.—If the Class R engines are rated 1,450 tons over a certain division, Class Q should be given 1,165 tons.

for a speed of approach of 15 miles per hour, reducing to five miles per hour at top, the length of grade being denoted by figures at top of line. These allow for the effect of momentum and the diminished T at the higher speed. The short line at lower left-hand corner gives the ratio for equating curves and grades; thus, add to the actual grade the grade corresponding to the curvature shown for the total effective grade. For empties operated under momentum rules, from the intersection of tonnage line and "dead pull curve" follow directly down to the "empty" line, which gives the empty rating for the corresponding case. Diagram No. 5 gives the same data for a speed of approach of 25 miles per hour, and Diagram No. 6 at 35 miles.

To illustrate: The engine selected as the standard can haul 1,750 tons up a 21-ft. grade on a "dead pull." On a 34-ft. grade with a dead pull, 1,250 tons would be the limit. However, on a hill of this grade 9,000 feet

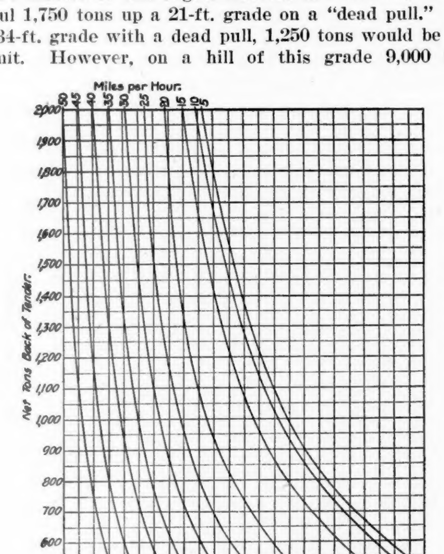


Diagram No. 9—Engine Loading, Dead Pulls at Various Speeds.

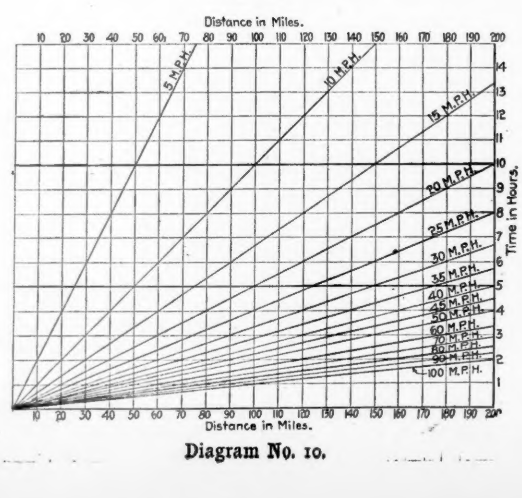


Diagram No. 10.

long and with a 35-mile an hour velocity at the foot, 1,450 tons can be taken up. If empties compose the train, 1,300 tons would be the allowance. By this means it is easy to rate the "standard engine" over the whole road. In order to simplify the rating of other classes, we have recourse to Diagram No. 7. This gives the load suitable for an engine having a different T when the load for the "standard" engine is known. These lines are not radial, as would seem at first sight, but are parallel to radial lines whose tangents are proportional to the T of the different engines, the parallel being drawn below the radial lines by the amount corresponding to the weight of engine and tender. In this way, the loads back of tender are comparable by the diagram, whereas it would be the power at the drivers were the radial lines used. The diagram is drawn for other hypothetical engines to compare with the standard, assumed engine and tender weights being allowed, and it being further supposed that the boiler has about the same proportions relatively to the cylinder power.

Diagram No. 8 and the following table are reproduced from one of the Division Time Cards of the Chicago & Northwestern, and explain fully how the chart is used.

Class "R" Ratings for Freight Trains.—Wisconsin Division.

	Dead.	Time.	Empties.
Princeton to Fond du Lac	860	775	800
Fond du Lac to Princeton	1,260	1,140	1,150
Fond du Lac to Sheboygan	770	690	720
Sheboygan to Fond du Lac	930	840	870
Fond du Lac to Milwaukee (Helper Fond du Lac to Eden)	1,290	1,160	1,160
Milwaukee to Fond du Lac	1,060	960	970
Milwaukee to Chicago (Helper to Cudahy)	1,380	1,250	1,250
Chicago to Milwaukee	1,440	1,300	1,280
Green Bay to Appleton Junction	1,440	1,300	1,280
Appleton Junction to Green Bay	2,000	1,800	1,600
Appleton Junction to Fond du Lac	2,000	1,800	1,600
Fond du Lac to Appleton Junction	1,380	1,250	1,250
Fond du Lac to Janesville (Helper to Oakfield)	1,250	1,130	1,080
Janesville to Fond du Lac	1,120	1,000	1,030
Janesville to Chicago	1,120	1,000	1,030
Chicago to Janesville	1,160	1,050	1,050
Belvidere to Kenosha	900	840	875
Kenosha to Belvidere	900	820	810

Rating for other than Class R engines will be obtained from diagram.

It is hardly necessary to say that an accurate knowledge of the profile and alignment is necessary to properly rate an engine, as well as the crossings, water tanks, stops and methods of operation, as these all contribute to the success of the rating.

The use of the Diagram No. 8 simplifies the transfer of engines from one division to another, as the proper loading can be determined by a glance at the diagram, when the class is known. For example, in the table given above the rating for Class R engine from Chicago to Milwaukee is 1,440 tons. On diagram No. 9 we follow down the vertical line corresponding to 1,450 tons on the upper diagonal line, and the intersection with the various diagonals gives the proper loading; for instance, Class Q, 1,160 tons; Class S-3, 950 tons, and so on. As all locomotives have the class letter painted on the cab, the proper rating is easily determined.

The ratings explained have been based on a speed of 5 to 8 miles an hour for a dead pull or for a summit velocity of 5 miles an hour for momentum runs. It will often be necessary to determine what load could be hauled at a higher speed, or what speed could be obtained with the same weight of train on a grade less than the ruling grade. Diagram No. 10 has been calculated

for the standard Class R engine by using the data in Diagram No. 1 for the T of the locomotive, and the train resistance from Diagram No. 2. For example, it was found above that 1,750 tons was the "dead pull" limit for a 21-ft. grade. This would be at a speed of about 5 miles an hour. If, however, it be desired to maintain a speed of 20 miles an hour on this grade the load must be reduced to 900 tons, as will be found from the intersection of the 20-mile curve with the 21-ft. grade line. Or, on the other hand, the 1,750 tons could be hauled on a 5-ft. grade at 20 miles an hour. As previously explained, these curves will be approximately correct only for locomotives having about the same cylinder and boiler ratio as the Class R engine.

Diagram No. 10 is inserted to provide a quick method of determining the speed of trains when the time and the distance traversed are known. The intersection of these co-ordinates will give the average speed by interpolating between the diagonals.

National Local Freight Agents.

The National Association of Local Freight Agents' Associations held its fourteenth annual meeting at Denver June 12, 13 and 14. About 200 agents attended, many with their wives, nearly all coming from the Missouri River and points East thereof. Those from the extreme east and north went from Chicago by special train over the C., B. & Q., while those from middle and southern states went via St. Louis on a special train over the Missouri Pacific. These trains arrived at Omaha on Monday morning where the excursionists were entertained by the local associations of that city, South Omaha and Council Bluffs. They were shown about the three cities. Both trains left for Denver in the evening over the Burlington. After the convention a large portion of the delegations went by the Colorado & Southern to visit points of interest further west; they planned to go to Ogden by the Colorado Midland and Rio Grande Western, returning over the Union Pacific.

The reports of the officers showed the Association to be in a healthful condition, the Secretary reporting 58 local associations with an enrollment of nearly 600 individual members, of whom the Credential Committee reported 49 associations represented by 194 delegates. Lincoln, South Omaha and Council Bluffs have formed local associations and were admitted to membership in the National.

The Treasurer reported funds on hand of $745, and the per capita tax was reduced to $1.50 per individual member.

It was voted to change the name of the Association to "American" instead of "National," and to admit to membership cities of North America otherwise eligible. Several cities in Canada and Mexico are interested in the benefits to be derived from the Association.

The special committee appointed to simplify the method of handling United States Government bills of lading reported progress and was continued. The special committee to devise a method of marking bales of cotton recommended tags showing consignee and destination. The recommendation was adopted and referred to the Conference Committee to be taken up with a view to having it adopted by the Transportation lines.

Before taking up the topics assigned for the meeting a joint session was held with the Association of Car Service Managers, who were in session in the same building. At this session addresses were made by Messrs. Haskell and Prall, of the latter body. Mr. Prall complimented the Agents' Association for its excellent work and spoke at some length relative to the delay to cars at junctions, for which a remedy suggested was a common ownership of all cars not used exclusively in local traffic, each line subscribing an amount representing their requirements and that number of cars to be interchangeable as home cars. If in excess of that number the excess to be paid for at an agreed per diem charge.

In the regular meetings the discussions aroused great interest, and intelligent conclusions were reached. It was decided that cars containing bonded freight should be placarded, additional cards to be used when bonded freight is removed or added to the original loading. It was the unanimous opinion that metal tags should be used in marking iron pipe, rods, etc., which do not present sufficient surface for the full marking.

It was recommended that a joint messenger service be established between local freight offices and offices of commercial and fast freight line agencies, the expense of such to be shared by the offices receiving such service.

The following subjects were referred to the Conference Committee to take up with officials of proper departments:

1. A correct basis and practicable uniform method for computing the cost per ton of handling freight at local stations, as to just what employees and other expenses should enter into the calculation.

2. What means can be effectively used to protect the delivering line so as to subsequently identify the party who has signed a receipt and taken the property; with a recommendation that consignee should give a written order, his drayman or agent also signing the same order.

3. To determine the most accurate method to insure stowing freight in proper car and what distinction, if any, should be made in rate of pay of stower and truckman.

4. To take legal advice and report at next meeting upon the responsibility of railroad companies after signing for freight loaded on private siding until removed from same by switching engines.

Mr. T. P. Adams, agent of the Missouri Pacific at St. Louis, was re-elected president; James Anderson (B. & M. R.), Omaha, secretary, and C. H. Newton (Wabash), Toledo, treasurer. The place of meeting in June, 1902, will be Cleveland.

The Master Mechanics' Reports.

We print below abstracts of the various committee reports presented at the annual convention of the American Railway Master Mechanics' Association at Saratoga. The discussions, so far as we have received them up to the time of going to press, appear in the current report of the convention, and the publication of these will be concluded next week.

CAST-IRON AND STEEL-TIRED WHEELS.

Since the date of the last report of this committee there have been practically no new developments and no new information obtained bearing on this subject. The committee has nothing, therefore, of value to present. Since the last report of this committee the question has been raised as to the expediency of the use of steel-tired wheels under 100,000-lb. cars, but the data in this matter are so deficient that they cannot be properly made a subject of report. The committee has nothing further to say, and feels that it should be discharged.

This report is signed by J. N. Barr, chairman; A. M. Waitt, A. L. Humphrey, H. S. Hayward and John Hickey.

COST OF RUNNING TRAINS AT HIGH SPEED.

The report contains extracts from replies to a circular letter, the most interesting being a letter from Mr. F. A. Delano, of the Chicago, Burlington & Quincy, and a member of the committee. Mr. Delano says in part: "I submit as evidence on this matter of cost of running trains at high speed a report made in July, 1900, on the C., B. & Q. R. R., under my jurisdiction on fast mail train No. 15, between Chicago and Burlington, a distance of 206 miles, the schedule of the train, including stops, being 51 miles per hour. Three trips were made with this train and two trips were made with a dummy train of practically the same weight, but making only half the speed. The data of the tests is given fully in the report made by Mr. M. H. Wickhorst, Engineer of Tests, who had direct charge of the work, with a staff of assistants, but I would call attention to several particular features.

"1. The test was made at a time of the year most favorable to low cost of train operation.

"2. The train was exactly on schedule time and there was, therefore, no time to be made up and no accident or hot boxes causing a delay which had to be made up.

"3. In spite of the above fact, it is interesting to note the speed at which most of the miles had to be made in order to keep the train on schedule time. It will be noted, for example, that the greater part of the distance had to be covered at a speed of 60 to 65 miles per hour.

"4. It is estimated that the value of the high-speed engine on the fast mail train (weighing 74 tons in working order) was $14,000, as against the value of say $7,000 for the engine (weighing 41 tons in working order) which handled the test train operating at only one-half the speed.

"I would submit as an answer to your other queries, the following: In regard to breakdowns, it is pretty apparent that there are a great many more cases of delayed trains due to hot bearings on engines and cars where the speed is excessive than where it is moderate. On some divisions of the road where speed is moderate we never have a case of hot crank pins, whereas hot crank pins and hot driving boxes are not uncommon in high-speed service. We use our very best power in high-speed service, and in spite of this we have more failures in high-speed service than in moderate service, but just how much more I am unable to say. I feel quite certain that the increase in speed of a few trains has a tendency to quicken the speed of all trains, first, because the men get educated or keyed up to a high speed, and secondly, because it is necessary to make high speed in order to keep out of the way of trains, even on a double-track road.

"The greater speed of trains, both freight and passenger, which has come with recent years has greatly increased the requirements for large boiler capacity of freight as well as passenger engines. High speed has developed a good many weak points in the machinery of engines which under more moderate speeds gave good service. There is very little question that this enhances the first cost of the motive power, but just how much it would be difficult, if not impossible, to say. To combine speed with great tractive power is a difficult thing to accomplish, because in the nature of things the requirements are contradictory, and in attempting to satisfy opposing conditions is of course more or less of a compromise."

The principal average results of the Burlington test are shown by the following figures from Mr. Wickhorst's report:

	Train No. 15. per cent.	Special train. per cent.
Speed, miles per hour	100	50.7
Drawbar pull, per ton	100	46.5
Water, per ton mile	100	68
Coal, per ton mile	100	54.5

"In general, therefore, we may say that these tests indicate the cost for power as represented by the consumption of coal and water, of running trains, increases directly as the speed; that is, if we double the speed, the coal, water and drawbar pull are likewise doubled." . . . The committee says in part: The tests made by the Burlington Road are of great value so far as they go, and clearly indicate that, so far as coal consumption is concerned, it is fair to assume that the cost increases directly as the speed increases, but the committee realizes that this is only one of the items of the enhanced cost of running trains at high speed.

The greater capital invested in locomotives capable of handling trains at high speed, the greater cost of maintenance, represented in the greater care and more perfect inspection, is spoken of by all who have replied to our queries. Furthermore, it is a pretty generally acknowledged fact that any given class of power will show far more engine failures operated at high speed than at lower speed; that the "keying up" of the service on a few trains tends to key up the service of all trains, and that while there is an undeniable benefit resulting from the greater alertness on the part of employees, there is an expense resulting from these greater demands on engines, requiring more expensive motive power, from machinery failures in both engines and cars, resulting from this greater speed, more serious results from derailments or accidents when they occur, or which involve an expenditure of money to prevent.

The committee has only considered the question of cost of running trains at high speed as affected by mechanical considerations. None of the other features of the problem, such as cost of track maintenance, cost of keeping the track clear, keeping trains out of the way of high-speed trains, and many other incidentals, have been considered at all. The attention of the committee has been called to various magazine articles and articles in technical journals on this question, all of which seem to fog the issue by not making a clear distinction between the question of "What it costs to run trains at high speed" and the question of "Whether it pays to run trains at high speed." Obviously the two questions are entirely separate and distinct. What it costs to run trains at high speed is a question susceptible of more or less scientific and complete analysis; while the question as to whether it pays to run trains at high speed is purely a commercial question, even more difficult to solve, because the question of earning power, advertising value and many other considerations enter in, as well as the question of expense of operation.

This report is signed by Wm. McIntosh, chairman; G. F. Wilson and F. A. Delano.

HANDLING, CLEANING AND SETTING BOILER TUBES.

A circular letter of inquiry was sent to members, to which 27 members replied. In general it was learned that the methods are practically uniform.

Tubes should be cut out of both tube sheets with a power cutter and removed through the dry-pipe hole, providing the pipe has been taken out. Otherwise through a tube hole that has been reamed sufficiently large to admit of the removal of the tubes, according to the probable amount of hard scale they may carry. The ends remaining in the front sheet should be driven out with a pneumatic hammer and chisel. The ends remaining in the back-tube sheet should be removed in a similar manner. A heavier hammer, however, is needed for this, with an ordinary flat chisel about ½-in. wide or split caulking tool. The labor of chipping off beads can then be dispensed with. They should then be taken to the rattler for the purpose of removing the scale. Safe ends should be cut off and scarfed and piled near the furnace with the horning anvil where the tubes should be opened and the safe end applied. After this operation they should be piled convenient to the welding furnace.

The safe end should be the same thickness as the original tube and should be applied to the end of the tube having previously received a safe end in order that the thicker end of the tube be used for welding. After the weld has been made and scale scraped off the tubes should be swaged about 5-32 in. and stood up in quicklime for annealing. They are then cut to length, and the front end opened on the horning anvil and are then ready to be replaced.

It is not necessary to test the welds on tubes until they have been reset; it is more economical to remove a defective tube occasionally than to test each tube separately. Before setting tubes, copper ferrules should be rolled into the holes of the back-tube sheet and tubes driven into them. The back ends of tubes should be set with a Prosser expander and after peaning over rolled with a roller expander and beaded with a pneumatic hammer and beading tool. The front ends should be rolled with a roller expander.

The fuel used is rather a matter of cost, according to local conditions, than of specific kind. Where coal or coke is used it should be fed to the furnace by means of a hopper. In case of burning oil, it should be applied with a burner at both ends, especially where tubes are being heated from both sides of the furnace.

The rattler should be hexagonal, or if of large diameter, octagonal in shape. One section should be secured by key bolts, that it may readily be removed by a pneumatic lift. By giving the rattler a half turn, all flues will be discharged at one operation upon an inclined plane in order that they will roll clear of the machine.

The committee recommends the scrapping weight of

tubes for boilers carrying 200 lbs. boiler pressure as follows: 2-in. tubes, 1.65 lbs. per foot; 2¼-in. tubes, 1.85 lbs. per foot. From this it is obvious that a heavier tube will have a greater percentage of service metal.

No definite information was received regarding the merits of steel tubes as compared with charcoal-iron tubes. The experience with steel tubes seems to have been very limited. The opinion of the majority favored charcoal-iron tubes from the fact that they pitted less and would hold a better bead. The principal trouble, however, was in the welding of steel tubes to steel safe ends. The committee is not prepared to say how much of this is due to the inexperience of the operator or to the metal itself.

This report is signed by W. H. V. Rosing, A. E. Miller and C. H. Doebler.

WHAT IS THE MOST PROMISING DIRECTION IN WHICH TO EFFECT A REDUCTION IN LOCOMOTIVE FUEL CONSUMPTION?

Twenty-six replies were received to the question asked in the title, a résumé of which is as follows:

	Replies.
Compounding	7
Wide fire-boxes	3
Increased grate area	6
Proper depth of fire-box	1
Piston valves	1
Increased boiler capacity	1
Power in good condition	2
High power in compounding	1
Brick arches	1
Feed-water heaters	1
Improved valve motion	1
Reduce clearance space in cylinders	1
Use exhaust from air pump	1
Use exhaust from cylinders	1
Reduce back pressure	1
Large outside lap and no lead	1
Improved steam distribution in cylinders	1
Increased length of tubes	4
Simple smoke arch draft rigging	1
M. M. standard front end	1
Coarse netting and large nozzles	1
Traveling firemen	6
Light intermittent firing	3
Keep level fire	1
Avoid use of hoe	1
Prevent excess of air in gases	1
Reduce quantity of solid fuel thrown out of stack	1
Perfect combustion	1
Check coal consumed each trip	1
Engines adapted to service	1
Engines in constant service	1
Uniform grade of coal	1
Avoid poor meeting places and stops	1
Avoid wasting coal by overloading	1
Continued attention to details	2
Automatic stoker	1
Patent fuel economizer	1
Bates fire door	1
Gangway fenders	1

All of the recommendations have merit, and if properly applied and operated will result in a reduction in coal consumption. Considering the several recommendations, compounding was the most frequently referred to by those replying to the circular. A prominent locomotive builder said last year of the road engines turned out for this country 70 per cent. were compound. Another principal locomotive builder said that 50 per cent. of the road engines for this country turned out of their shops within the last year were compound. Compounding has passed the questionable or experimental stage and is now so generally recognized as one of the known methods for effecting a reduction in locomotive fuel consumption as to not warrant making it a special feature of this report. The committee is further of the opinion that the Association should in justice to itself give its approval or condemnation of the compound locomotive, and place itself squarely before the world as to why it does so. Engines possessing this feature where skilfully operated have demonstrated that they are fuel savers of from 15 to 25 per cent., as compared with single expansion locomotives.

Feed-Water Heaters.—Using the exhaust steam from air pump and cylinders for heating feed water is one of the most promising directions in which to effect a reduction in locomotive fuel consumption. This feature can be applied to existing engines with a moderate expense and but slight changes. The average yearly temperature of water as delivered to locomotive tenders is from 50 to 60 deg. F. For every 12 deg. that the temperature of the feed water be raised by exhaust steam or waste gases before the water enters the boiler there will be a saving of 1 per cent. in fuel. If by the means recommended an average temperature of 200 deg. for the feed water can be maintained a saving of 12 per cent. in fuel would result. The method recommended for accomplishing this is illustrated in Figs. 1 and 2, and consists of a steam pump adapted to handle hot water. The exhaust from the air pump, water pump, and a branch from the exhaust in the front end, to be discharged into a portion of the tank, which we will designate as the hot-water tank.

The hot-water tank will have a capacity of 300 to 400 gallons of water. The partition will be water-tight, with the exception of a ½-in. space at the bottom, through which the water will maintain a constant level on both sides of the partition. The exhaust from the cylinder saddles is conducted to the rear of the engine through a pipe, as shown in Fig. 1 at A; and the exhaust from the water and air pumps, as shown at B

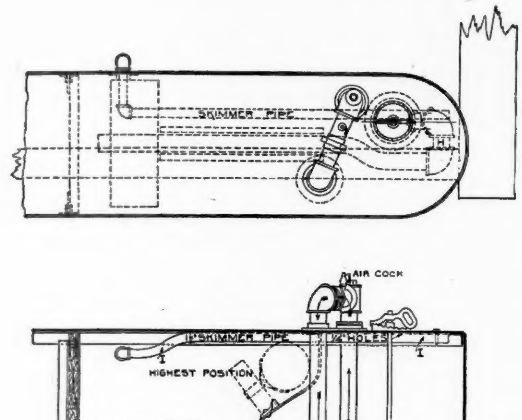


Fig. 2.—Arrangement for Exhaust Steam in Tank.

and C, joins this piping, which enters the bottom of the hot-water tank at D, and is then conducted up through the tank to the top and through a return bend back to within two inches of the bottom of tank, where it terminates in a bell-shaped open end through which the exhaust escapes into the water. In the exhaust pipe and between the pumps and cylinders is placed a shut-off gate at E, to close the exhaust from the cylinders to tank if desired; also a gate at F where pump exhausts may be cut off from the tank and delivered to the front end.

The suction pipe for the water pump is arranged to draw water from 4 in. below the surface of the water in the hot-water tank, the suction end being supported by a float or buoy, as shown in Fig. 2 at G, which rises and falls with the level of water in the tank. The other end of the adjustable pipe connects with a flexible joint at H, and forms a connection through the tank valve case in the bottom of the tank to the hose and pump. In the top of the hot-water tank is a perforated pipe, I, which connects to the pipe running down through the coal space to the under side of the tender frame. When the tank is full of water this pipe acts as a skimmer to get rid of the oil coming in with the exhaust. It also acts as a safety valve for the escape of steam, should the water in the hot-water tank get to a higher temperature than 212 deg., and thus prevent the hot water being forced out under the partition and into the cold water portion of tank.

The engine should be equipped with an injector large enough to supply the boiler when worked to its full capacity. The injector should be located on the right-hand side, but should take its water from the left-hand leg of the tank. This arrangement should prevent the danger of trouble or delay on the road caused by the failure of the hot-water pump or any of the heating appliances, leaving the injector practically cold water to draw from should it be necessary to use it.

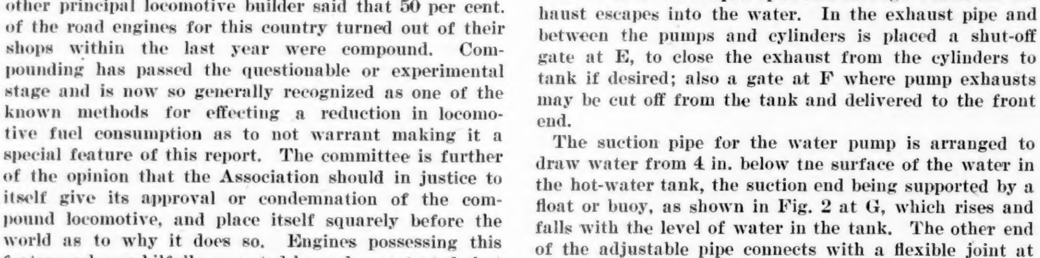


Fig. 1.—General Arrangement of Feed Water Heater.

Wide Fire-boxes and Increased Grate Area.—To-day a majority of engines for road service now building have this feature. Increased grate area is so closely allied to wide fire-boxes as to properly be considered in the same connection. One member who has made fuel combustion and gas analysis in the locomotive a special study, says: "There are three sources of preventable loss coming under this head, which, in my opinion, may be reduced.

"1. Incomplete combustion.

"2. Heating unnecessary excess of air in the gases.

"3. Reduction of the quantity of solid fuel thrown out of the stack.

"The first and second may be effected by improved methods of manipulation, which can be determined by chemical analysis of the escaping gases. The incomplete combustion loss is the larger one in locomotives, which is contrary to that in stationary furnaces and boilers, where unused air carries away more heat than is lost by incomplete combustion.

"The most effective way to reduce the third loss would be by the use of larger grate areas, which would afford a freer air supply and from the reduction of the resistance of the fuel bed there would be a lower suction over the fire, consequently less small fuel would be carried out with the gases. Careful manipulation of the fire with small grates will have an influence in the same direction, because the resistance through the fire would be reduced.

"I cannot recommend any special device except larger grates although there is an opportunity of improvement with very large engines with small grates where the necessary resistance through the fire is abnormal, or where it is impossible to get sufficient air into the fire with prevailing practice. The remedy would be to introduce air over the fire. This is not recommended, however, unless shown necessary by tests of the combustion and its application and operation determined likewise.

"Complete combustion with 12 or 13 CO_2 may be secured in locomotives, and under these conditions the loss in the hot gases, based on their escaping at 800 deg. F., would be about 24 per cent. Under such conditions, in stationary practice, an economizer would afford means for recovery of about 10 or 11 per cent., but for several reasons such means are not applicable to locomotives. The usual locomotive as compared with the average stationary boiler and furnace furnishes an opportunity for a more efficient condition of combustion, but it has the disadvantages of a somewhat higher temperature of escaping gases, a very much greater loss in the form of solid fuel, and a very much greater radiation loss from the boiler.

"The above remarks concerning excess of air do not apply to engines with extremely large grates, because with them the loss on this account may be considerable."

We are not prepared to recommend a definite proportion of grate to cylinder or heating surface, or the relative width to length; neither do we believe that such proportions can be correctly given and have them apply to all grades of fuel and classes of service. However, from information received from those who have had the most experience with wide fire-boxes and increased grate area, and from reports of combustion tests showing the gas analyses of different sized grates and fire-boxes, we feel warranted in placing this feature among the methods by which some improvement in fuel economy may be effected, but all the conditions should be carefully considered before a radical departure is made from the deep and narrow box.

An uneconomical feature of the large fire-box and increased grate area is the heating of unnecessary excess of air in the gases. This can be kept down to a minimum by careful firing and well-fitting ash pans and dampers, if the latter be carefully manipulated. Adjustable grates, whereby the air space could be enlarged or decreased at will, might, if such a device could be made entirely reliable, better perform this part, but we know of no grate that has withstood the test of service that will fill the requirements. Another feature is the greater amount of coal that must be burned on a large grate while the engine is standing still and the greater care required to hold the steam below the popping-off point. The safety valve, if allowed to frequently perform its function, will be very wasteful of coal. This loss has been figured out as equal to ¼-lb. of coal per second, or a small scoopful per minute. Wide fire-boxes when operating under favorable conditions and burning fuel suitable to their construction, will develop economies worthy of consideration. But in a service where much of the time is spent standing still and the fire being kept in a condition to go whenever the signal is given, enough fuel will be wasted while standing still to overcome the economies obtained while running.

Instructing Enginemen.—The traveling engineer and fireman may be, and usually are a great help in producing results in fuel economy. Unless the engineer and fireman earnestly take an interest in economically performing their work good results will not follow. Many useful devices to assist in making or using steam have proven a disappointment to their inventor on account of the lack of interest or intelligence in their use. One of the important necessities in obtaining economical fuel performance is to get intelligent and earnest support all the time from the crew operating the engine. How can this be done? One member says, "Check the coal consumption each trip;" another, "close attention to

details." These, if followed, must bear fruit. If the monthly performance sheet be depended upon for information showing the poor performance of engines, the loss at best will have been going on for a month or more. A daily check of the coal consumption admits of the remedy (when necessary) being quickly applied. All other details, if closely watched, will result in quickly weeding out that which might prove to be an expensive irregularity.

Assigning regular crews to engines has the effect of stimulating an interest in the work and exciting a rivalry between the men in the same class of service on different engines that must result in economy. The remark is sometimes heard that "enginemen don't own their engines any more." Would it not be to the interest of the railroad companies to revive that old-time love for the engine which formerly existed in every engine crew?

Reduction of Cylinder Clearance.—This is a recommendation of one member. In this case it is represented that it is not only possible but practicable to reduce the clearance to 2 per cent., while in the existing single expansion locomotives the clearance varies from 4 to 10 per cent.

Engines Adapted to Service.—This will prove economical, not only so far as fuel consumption is concerned, but in every other way. The operating of high-speed trains with small wheel engines, running them at an excessive piston speed, or running large engines where smaller ones will do the work, will always prove expensive from a fuel standpoint.

"Engines in constant service" is recommended by one member as a promising direction in which to effect a reduction in locomotive fuel consumption. If considered from the standpoint of keeping constantly in motion after starting out on a run, the result will be economical. Bad meeting and passing points leave their mark on the performance sheet. Short divisions with frequent lay overs, or excessively long runs on which the fire becomes clinkered, are not conducive to fuel economy.

On most roads at the present time the results shown on the performance sheet are based on the gross tons hauled one hundred or a thousand miles, and in order to make a favorable showing full tonnage must be hauled. The run should, in order to prevent loss at terminals, be as long as both the fireman and fire can be kept in good condition. An exhausted fireman, or a dirty fire, will not save fuel, and when the engine arrives at a terminal the layover should be sufficiently long to allow of the flues, arches and grates being well cleaned before starting out on a trip.

Uniform Grades of Coal.—This is another important factor in fuel economy, especially when the grade of the coal varies and requires different treatment in both draft and firing. Coal of the same general grade should be furnished to a section or division and the engines kept where they will get but one grade. Coal should be delivered to tenders broken to proper size for burning in order to give the nearest to perfect combustion. The tender should not be overloaded to the extent that coal will fall off along the road, and the gangways should be properly guarded to prevent loss at that point. Loss at the coal docks should be closely watched.

Length of Flues.—When it is considered that coal is the largest item of expense in the operation of a railroad, it is not surprising that this Association should at every convention have some question up for consideration and investigation bearing on fuel economies, and so long as 20 to 30 per cent. of the value of the fuel passes out of the smoke stack as waste gases at a temperature of 600 to 1,000 degrees, it is but natural that an investigation should turn in this direction with the hope of still further absorbing the heat from the gases, and that the length of the flue should be looked to as one of the possible means of doing so.

From a fuel standpoint, what is the economical length of a 2-in. flue? The committee is not prepared to furnish any information on this point, but feels that it is a subject worthy of a very thorough and careful investigation. There are those here who can remember when 10 or 11 ft. was the maximum length for a locomotive flue. To-day from 16 to 18 ft. is quite common practice in new engines, and 19 ft. has lately been tried; yet, so far as we know, the Association or the members are not satisfied as to whether the economical length for a 2-in. flue has been reached.

Superheating.—Superheating of steam is much in favor in stationary practice in Europe, and is beginning to receive considerable attention in this country. We understand that to some extent efforts have been made to apply the principle to locomotives with economical results, and that tests are now under way in this country along the same lines. If its application to locomotives can be made entirely practicable it may be one of the means of determining the economical length of the flue; but both these points are worthy of consideration and might furnish a fit subject for the special investigation of a committee.

Bates Fire Door, Etc.—Bates fire-doors, Master Mechanics' front ends, outside lap and no lead on valves, coarser netting and large nozzles, and piston valves have also been suggested to your committee as means by which saving in fuel might be effected.

Automatic Stokers.—Automatic Stokers are being used for a double purpose. It is expected by those personally interested that economical results in the use of fuel will be obtained and at the same time the labor of the fireman will be considerably lightened, requiring less effort and skill on his part to feed and operate than when doing the work by hand. We mention it as a line which is receiving some consideration, and may in the near future present some desirable features in connection with the use and handling of fuel on locomotives.

Conclusions.—After considering the several recommendations the conclusions reached by the committee are that the most promising directions in which to effect a reduction in locomotive fuel consumption must be largely determined by each particular railroad for itself, the methods varying to suit the local conditions.

A reduction in fuel consumption has resulted from compounding whenever the engines were intelligently handled. This feature seems to us to be one of the most promising directions and the one that would yield the largest per cent. of saving.

Wide fire-box and increased grate area should be one of the means of effecting a reduction in locomotive fuel consumption.

As to economical length for locomotive flues, we have no definite recommendations to offer. The uneconomical length for flues has not yet been reached.

Using of the air pump and a portion of the other exhausts for heating feed water appears to be one of the most promising directions by which to effect a reduction in locomotive fuel consumption.

This report is signed by A. E. Manchester, A. Forsyth and A. F. Stewart.

AN UP-TO-DATE ROUNDHOUSE.

The length of the roundhouse should not be less than 80 ft. in the clear. Doors should have a minimum height and minimum width of 16 ft. and 12 ft. in the clear, respectively. The upper portion of the door should have as much light in as can be obtained without interfering with its strength. The window space should be as ample as considered consistent with the strength of the walls in the outer circle of the roundhouse. In roundhouses 80 ft. length we must arrange for additional light. This can be done as shown in Figs. 1 and 2, without necessitating skylights which continually give trouble from leaking. Roundhouses having roofs like Figs. 1 and 2 can be seen in actual use at Norfolk, Va., and Mason City, Ia. Engines should head into roundhouses of modern type, first, because of the more room afforded at the outer circle of the house, where most of the work on the engines is done when headed in in this manner; second, because of the increased light that can be obtained. The location of smoke-jacks will be determined by taking the dimension of the longest engine and dividing space up equally at either end. In the North, on account of the cold weather, it is necessary to use smoke-jacks. In the South, continuous ventilators (as shown in Fig. 1) give good results. The committee would recommend that ventilators be used at least in every other stall, with a minimum dimension of 3 x 4, and not less than 2 ft. in height, and these to have the usual slats in the sides. In the northern country we recommend that a damper or drop-door be placed in the bottom of each ventilator so that they can be closed up in winter time when necessary. In the South it is not considered necessary to have these additional openings where they have the continuous ventilator at the highest point of the roof, which is used instead of smoke-jacks, as shown in Fig. 1.

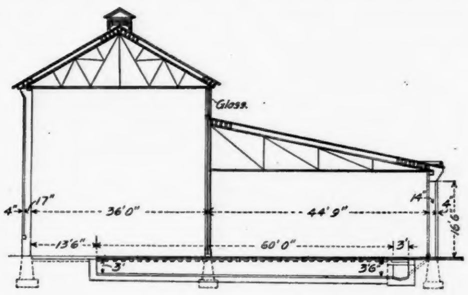


Fig. 1.—Norfolk & Western Roundhouse.

The length of pit should be 60 ft., the depth to be governed by the type of power used. For example: If engines have large fire-boxes, and the wheels are 63 in. and upwards over all, we recommend that the pits be 2 ft. 6 in. minimum depth, and 3 ft. maximum depth. If the wheels of the locomotive are low, and most of them deep fire-boxes, we would recommend that the pits be 3 ft. minimum and 3 ft. 6 in. maximum depth. Two methods of supporting the rail on top of the pit walls are in vogue. One consists of placing short ties extending to the edge of the pit wall and about 2 ft. long, the space in between them being filled with concrete, which helps to support the rail in case the tie should soften under the action of wash water, etc. The other method consists in surmounting the pit wall with a timber about 12 in. square, upon which the rail is spiked. This construction, however, is much more expensive than the former, and apt to deteriorate more rapidly. In either case provision should be made for raising the engines by jacks. In the first arrangement of pit this is provided by placing a 4 x 12 timber on top of the ties just outside of the rail, whereas in the latter construction a timber sometimes 12 x 16 is placed on edge immediately next to the rail sill, which gives ample strength for the base of the jacks, this timber being supported by piers or pilasters from the main pit wall. In either case the pit wall should be designed to form proper support for the jacking timbers. It is quite important that the sills which support the rail be kept as dry as possible, and as water will accumulate between the floor and the outside of rail, it is preferable to have this filled in either with wooden strip or cement, or if this is not done, to provide proper drainage under the base of the rail so that water running into the groove can continue down into the pit. This can be done by means of cross-notches underneath the base of rail about every 3 ft.

The floor of the pits under the engines should be convex, and is best made of brick on edge on a concrete bed. The drainage of the pit is important. The old-time method of having pipes and gates was a continual source of annoyance, as these pipes would continually choke up with waste and other refuse. Many modern houses have the engine pits extend to an annular pit, which is just inside of the main doors, this pit being made lower than the engine pits. This annular pit should be drained at some suitable point into the turn-table pit or system of drainage.

An up-to-date roundhouse floor should be of vitrified brick laid on edge in a bed of sand, and the committee would recommend a concrete bottom and then a layer of sand in which to bed the vitrified brick. When brick is laid, the floor should be covered with a layer of sand or tar (tar preferable) to fill in the joints. We also recommend that the water and blow-off pipes be placed in the annular pit, all other pipes to be placed overhead, with drop-pipes between every other pit, with suitable hose connections to connect with the locomotives. The blow-off pipe from the top of the dome to be connected with short pipes through the roof over each pit, connection with the engine to be made with flexible metallic joints.

We would recommend that the stationary boilers which are used for steam heat, pumping, machinery, etc., carry 125 lbs. steam pressure, and that the steam be conducted through the house in pipes not under 1½ in. in diameter. It is recommended that compressed air be supplied at 100 lbs. pressure, as this is the most suitable for general uses. The most modern method of heating at present seems to be by hot air and forced blast.

One arc light should be located over the center of the turn-table, and not less than three 16 candle-power incandescent lamps should be placed between the pits; one about opposite the cylinders, another about opposite the cab, and the third about the center of the tank. There should also be located in convenient places in every other stall two connections for portable lamps for pit work and fire-box work; all lamps to be covered with wire guards for protection.

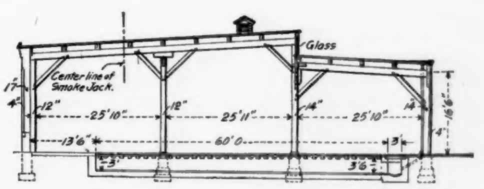


Fig. 2.—Chicago & Northwestern Roundhouse.

The committee is unable to satisfy itself on a roundhouse smoke-jack that would meet with general approval, but we are agreed that the smoke-jack should be made telescopic to fit the stack. It should also have a certain amount of swing parallel with the track, so as to provide against its being pulled down should the engine move with the jack resting upon the engine stack. The smoke-jack should be provided with a damper, so that when the engine is put into the house and no fire on the grates, it will prevent the cold air from passing up through the flues. We also are of the opinion that a lever ought to be used to raise and lower the jack instead of the cable and sheaves as are commonly used.

Every modern roundhouse should be provided with a drop-pit for removing driving wheels, extending across two tracks; also one closer to the outer wall of the house for removing truck wheels. These pits should be so arranged that the wheels can be removed from an engine on one track, and run over to the adjacent track, and then lifted up to the floor. Jacks are preferably worked by power. The hydraulic power has the advantage in that there is not the same elasticity and vibration that is noticeable when air is used. When new tables are being put in, the committee would recommend that they be made at least 70 ft. long and well braced. Experience shows that the long table with a load on it is more easily handled than the shorter table with the same load. The committee recommends electric power for operating turn-tables in preference to any other in use. If, however, there is no electrical power available, the gasoline engine can be used successfully.

The committee recommends as many wall benches supported by brackets as there are stalls, and in addition to these, several portable benches. Every well-managed roundhouse should be provided with a tool room. An annex should be provided to contain the necessary boiler, pumps and machine tools for making ordinary running repairs, as well as a room for supplies. We would recommend the following machinery, namely: One 30-in. engine lathe, one 12-in. engine lathe, one 30 x 30-in.

planer, one 24-in. drill-press, one 20-in. shaper, one grindstone, one bolt-cutter, one screw or pneumatic press for rod bushings, one blacksmith forge and anvil, etc. Where size of cylinder demands it, the large lathe should be increased to 36 in. We further recommend that the following portable tools be provided, namely: Portable crane, valve-facing machine, air motors, air drills and hammers, cylinder boring machine, valve-setting apparatus, chain block and fall, hydraulic jacks, small air press, pinch bars, chain tongs, wrenches, etc. For handling ashes and cinders, the cheapest arrangement, and one which is least liable to cause trouble by breaking down, is a depressed track between two tracks, the depressed track to be deep enough so that the ashes can be hoed from the cleaning floor directly into the ash cars.

It is thought desirable by the committee that each engine should carry its own record as to wash-out, stay-bolt inspection, etc., and this can be most conveniently done by means of a card which is always visible in the cab of the locomotive, and can be turned in at the end of each month for file at the Master Mechanic's office. This should not, however, be construed as displacing the usual roundhouse records, as these should be available when the engine is on the line.

It is the opinion of the committee that stay-bolts should be tested once a month. The hammer test is satisfactory when bolts are completely broken through. When only partially broken it does not tell the story. Where tell-tale holes are drilled, or hollow stay-bolts used, a careful inspection of the tell-tale hole for the presence of lime is considered most satisfactory. It is also desirable that a record should be kept of all such tests. In making the hammer test, about 40 or 50 lbs. of steam or air pressure should be used in the boiler to separate the ends of the broken bolts.

The opinion was held almost unanimously in favor of machinists filling the position of roundhouse foremen. A few believe that engineers who are also machinists would make good men. The committee is of the opinion that it is very necessary that a roundhouse foreman should have had practical experience as a machinist, and that if he could have some experience as either a locomotive fireman or an engineer, it would make him a better roundhouse foreman than he could be without such experience, as he would then know the conditions that exist on the road, and could therefore do more intelligent work.

This report is signed by Robert Quayle, Chairman; D. Van Alstine and V. B. Lang.

LOCOMOTIVE MILEAGE.

There is no limit to the mileage it is advisable to make, consistent with proper maintenance of the power and sufficient rest for the enginemen. By getting the maximum possible mileage out of power, fewer engines are needed, and a great saving is made in outlay for equipment. It is best to get the full service from our engines quickly so they can be replaced with more modern power. The factors controlling and limiting the mileage are many, and vary on different lines. They may be grouped into three general classes with sub-divisions, as follows:

1. Physical nature of the road. a. Length of divisions. b. Character of grades and curves. c. Number of stops necessary.
2. Transportation methods. a. Schedules. b. Number of trains run. c. Variation in traffic. d. Condition of equipment.
3. Motive power methods. a. System of crews. b. Roundhouse practice. c. System of running repairs. d. Adherence to standards.

The best practice as reported by 30 separate lines is given in the table below, and we can simply take these results as a high standard and endeavor to follow and improve on them.

That it would be possible to improve on these results under special conditions is indicated by the fact that the average of replies from all 30 lines gives 7 hours for passenger and 6½ hours for freight as the necessary lay-over at the home terminal to properly care for the engines. The lay-over at the other terminals can theoretically be much less.

Length of Divisions.—It is often possible to lengthen out divisions, and the table below indicates the great advantage of doing so. This table shows an average of practice, and each road is given the same value regardless of the number of engines on its several divisions.

Monthly Mileage on Different Divisions.

	100 Mile.	125 Mile.	150 Mile.	175 Mile.	200 Mile.
Passenger	5,037	5,605	6,487	7,071	7,331
Freight	3,720	4,258	4,416	4,758	5,125

It will be noted that the average of 30 roads would indicate that engine mileage can be increased in both passenger and freight service, in about the same proportion as divisions are lengthened from 100 to 200 miles. For various practical reasons the committee would recommend that all divisions be lengthened so that the average service will consume from eight to ten hours between terminals.

Character of Grades and Curves.—The effect of grades and curves in reducing the speed of maximum trains, and consequent lengthening of the time between terminals, greatly reduces the monthly engine mileage, and probably more money has been spent on straightening curves and reducing grades, in the last ten years, than on any other improvements.

Number of Stops Necessary.—Heavy outlay has been made to enable trains to run at speed through small towns. It is often necessary to make stops that could be avoided by a better location of water columns, and many divisions could be bettered in this important matter.

Schedules.—Schedules may often be changed to better suit the motive power requirements. Engines need only be out of service for necessary repairs, boiler washing, etc., and the work can better be done, and is usually done at one end of the division where a lay-over is necessary. The lay-over at the other terminal can often be reduced. The average lay-over at the home and other terminal is given in the table below as reported for 30 roads, each road being given equal value in the averages, regardless of the number of engines in service.

Lay-Over at Home Terminal, Different Divisions.

Service.	100 Mile. Hours.	125 Mile. Hours.	150 Mile. Hours.	175 Mile. Hours.	200 Mile. Hours.	Av'ge. Hours.
Passenger	13	14	16	18	22	16.6
Freight	12.5	12.5	14.5	10.5	19	13.8

Lay-Over at Other Terminals Different Divisions.

Service.	100 Mile. Hours.	125 Mile. Hours.	150 Mile. Hours.	175 Mile. Hours.	200 Mile. Hours.	Av'ge. Hours.
Passenger	6	7	9	8	14	8.8
Freight	7	9	9	8.5	9	8.5

We would recommend that transportation departments arrange for a minimum lay-over away from the home terminal, and that crews be required to live at the point most conducive to economy of operation. It would be advisable, where practicable, to change the home terminal with the periodic change in direction of traffic, so as to put the lay-over at the proper business end of the division.

Condition of Equipment.—It is good business policy to run engines down and get all the mileage possible out of them before going through the back shop. It costs about the same for a general overhauling, if the machine is 75 per cent. run down with some one part broken, or if it is all run down together. To have all engines in good order would necessitate closing up repair shops for a season, or the shopping of engines before their general condition would demand it.

System of Crews.—The variety of service on each separate division of each line makes a separate and local problem of the method of crewing not only on each division but on separate runs on the same division. The tables below give the average mileage for different methods of crewing on different length divisions as reported by 30 separate roads, equal value being given to each line regardless of the number of engines in service.

Mileage in Passenger Service, Different Divisions.

Method of Crewing.	100 Mile Divis.	125 Mile Divis.	150 Mile Divis.	175 Mile Divis.	200 Mile Division.	Ave.
Single	4,066	3,980	4,276	3,933	4,000	4,051
Single with extra men	4,700	5,400	5,450	7,850	....	5,850
Double	5,500	6,626	8,300	9,066	8,150	7,528
Double with extra men	6,045	....	9,000	9,000	....	8,015
Pooled	6,000	5,500	8,000	....	9,250	7,187

Mileage in Freight Service, Different Divisions.

Method of Crewing.	100 Mile Divis.	125 Mile Divis.	150 Mile Divis.	175 Mile Divis.	200 Mile Division.	Ave.
Single	3,274	3,480	3,600	4,108	4,000	3,567
Single with extra men	4,425	4,500	4,200	....	5,000	4,450
Double	4,325	6,900	5,450	....	8,150	4,891
Double with extra men	....	....	5,700	....	....	5,900
Pooled	3,800	3,959	4,337	4,900	6,500	4,527

Monthly Engine Mileage Obtained.—The only way in the control of the machinery department to increase an engine's mileage is to reduce the necessary layover at terminals to a minimum. An average of replies from 30 separate lines gives 4,650 miles in passenger service and 3,550 miles in freight service as the monthly maximum it is considered enginemen should be allowed to make. On the other hand, an average of the same replies gives 4,250 miles in passenger service and 3,330 miles in freight service as the monthly mileage men are satisfied to make. Under normal conditions it would then seem that two men by continuous running can make regularly almost as great a monthly mileage together as is practicable for one engine. Enginemen get sick and occasionally lay off so that it can be assumed that for maximum monthly engine mileage we must utilize two and a fraction men for each engine in service. The problem is, then, how to best assign these men for the best interest of the service, the engines and the men themselves.

Variation in Traffic.—On account of the variation in business the ideal arrangement of crews would be to have a flexible system capable of expansion or contraction without hardship or loss of money to the older employees. Pooling is flexible enough, but it puts all men on exactly the same plane, and they fare alike. On roads where it is only practicable to make a low monthly engine mileage except during one or two very short heavy seasons, we would strongly recommend that the engines be regularly single crewed and special arrangements made during the short heavy seasons. Under such arrangements it is usual for the regular men to make all the mileage they wish, and allow extra men to make the balance. This is a bad practice in some ways, as it often occurs that at times of the heaviest traffic on the road, the enginemen, instead of being more than usually alert, are overworked and in need of rest.

The most flexible arrangement of crewing with consideration for the old and more competent runners would seem as follows, for a road with varying traffic:

First condition, normal, single crew.
Second condition, single crew and extra men.
Third condition, double crew.
Fourth condition, double crew and extra men.
For a road with more regular traffic:
First condition, normal, double crew.
Second condition, double crew with extra men.

Under these arrangements the older men are all regularly provided for. A special point should be made that no regular men be allowed to make over a certain fixed maximum monthly mileage until the extra men had made a certain fixed minimum mileage.

A Proper Spirit Among Runners.—This factor is one of the subtle ones that is not in any way mechanical, but the importance of which is thoroughly realized by every broad-gage railroad man. It is a solid fact that enginemen do not and never will prefer the pooling system. They have to share alike with every man in the pool, and good, bad and indifferent are all together. When the older, tried and faithful men have the best engines on the best runs, there is an incentive to the younger men to stay on that road and build themselves up. The extra list (that troublesome thing to maintain) has always good young men waiting for an opportunity, who, if business is slack, prefer to fall back to a switch engine or to firing in preference to going off on another line.

We have shown that, with the average of the best practice on 30 railroads, the largest mileage is not obtained on pooled engines, and for no other reason do we believe pooling to be recommended. We would recommend for maximum monthly mileage that all engines be double-crewed with extra men for relief, where other conditions will permit the engine to make mileage enough to keep two men busy.

Roundhouse Practice.—For large monthly engine mileage, the roundhouse and its methods are perhaps the largest single factors in the entire question. Practically the entire function of the roundhouse, aside from hostlering the engines, is to take the stitch in time that saves 99. The talent required to properly look after engines there is of a higher order than that needed in the back shop. Any mechanic can tell what is the matter with a driving box if it is out on the floor, but it takes more ability to locate a pound on an engine in the roundhouse, and find out which box is *going* to give trouble. We frequently see roundhouses insufficiently equipped with men and appliances for the proper handling of the work. It is the roundhouse that keeps engines in service, and we believe it is far better to thoroughly equip it with the best men and tools, before giving any serious consideration to the balance of the locomotive plant. We would recommend for maximum engine mileage that the very best talent we have be placed in charge of the roundhouse.

System of Running Repairs.—We believe that the roundhouse work should be subdivided as far as possible. It is often customary for the foreman to give out the various jobs to different men. He has a number of all-round men, but few specialists. We think it better where the roundhouse is large enough and the work can be specialized, for the engineman's and inspector's reports to be fastened together and posted, and that it be the regular duty of certain leading men to look after or do the work they are assigned to. This subdivision must vary on different divisions, dependent on the number of engines and men employed.

Conclusions.—Summarizing our conclusions, we recommend, for a maximum monthly engine mileage,

That short divisions be lengthened so that the average service will consume from eight to ten hours over the division one way.

That there be as low a maximum grade and degree of curve as practicable, and that helping engines be placed at one or two points on a division where the grade is considerably in excess of the rest of the division.

That unnecessary stops be eliminated as far as practicable by the better location of water columns.

THE BEST REPORTED PRACTICE ON DIFFERENT LENGTH DIVISIONS.

Division.	Service.	Monthly mileage.	Crews.	Layovers at terminals. Home. Hours.	Layovers at terminals. Other. Hours.
100 miles	Passenger	7,000	Double with extra men	30	6
100 miles	Freight	5,500	Double	8	5
125 miles	Passenger	8,300	Pooled	8	5
125 miles	Freight	6,900	Double with extra men	9	4
150 miles	Passenger	9,000	Double with extra men	10	4
150 miles	Freight	6,500	Double with extra men	6	3
175 miles	Passenger	10,000	Double	32	4
175 miles	Freight	6,600	Double	10	6
200 miles	Passenger	10,500	Pooled	20	5
200 miles	Freight	6,500	Pooled	8	8

That schedules be arranged to give reduced lay-over away from the home terminal.

That crews be required as far as practicable to live at the point most conducive to economy of operation, and to keeping engines in service.

That transportation officers avoid the demand for more power when during a short heavy season some other requirements of the service can be adjusted temporarily, thus avoiding the laying up of engines in normal season.

That transportation officers do not make the demand for *all* engines to be in good order, resulting sometimes in the purchase of new power for heavy seasons, when it might be avoided, and thus provide for increased mileage in normal seasons.

That engines be double-crewed with extra men for relief when there is enough work on one engine for two men. When this is not the case, that they be single-crewed with extra men for relief.

That special attention be given to the roundhouse force and equipment, and that it be the last place to suffer from reduction of force.

That the very best talent in the machinery department be placed in charge of the roundhouse work, and that system alone be not depended on for results.

That the inspection of engines be reported separately by the enginemen and inspectors, as a check on their attention to detail.

That the roundhouse work be specialized as far as possible, so as to avoid a division or uncertainty of responsibility.

That the existing methods be overhauled so that necessary routine work will not cause engines to lose their turn.

That with the change to the pooling system, adequate preparation be made for more careful inspection, and heavier charges to maintenance.

That interchangeability of parts be adhered to as far as practicable in various types of engines.

That we strive after simplicity of design, and adhere to what we know is right, unless there are excellent reasons for change.

This report is signed by T. H. Symington, Mord Roberts and George F. Wilson.

IMPROVED METHODS OF HANDLING LOCOMOTIVE COAL.

The committee presents drawings of typical coaling stations. The first shows the standard coaling crane of the Cleveland, Cincinnati, Chicago & St. Louis. This includes a coal wharf between tracks. The coal is unloaded from cars on one side of the wharf, then it is put in large buckets, which are handled by a crane in loading tenders.

A coaling station on the Chicago Great Western illustrates the common method of running coal cars up an inclined trestle, from which the coal is unloaded into elevated pockets. At the other coaling stations shown the coal is unloaded into a hopper and elevated and distributed by conveying machinery. These stations are as follows: Chicago Great Western, Oelwein, Iowa; Erie R. R., Port Jervis, N. Y.; Cleveland, Lorain & Wheeling, Canal Dover, Ohio; Northern Pacific standard power coaling station; Lake Shore & Michigan Southern 500-ton power coaling pocket; Lehigh Valley, South Plainfield, N. J.; Michigan Central, Jackson, Mich. The drawings are not reproduced here. The committee says in part: There has been no effort to present any data on the means of furnishing power to operate the conveyor or machinery in the plant, as location, surrounding conditions and amount of power required would have to be taken into consideration for each individual location. It is the opinion of the committee that the expense of coaling engines is governed entirely by the kind of cars in which the coal is handled, without reference to the kind of plant in which it is handled, provided the plant is one that will admit of dumping the coal to either bin or conveyor. If the coal is received in hopper bottom or side dump cars, the cost will probably be between 1 and 3 cents per ton delivered on the tender, no matter whether the cars are pushed up an incline and dumped into pockets, or whether the place of the switch engine is taken by other power operating a system of conveyors. On the other hand, if the coal is received in gondola or box cars and has to be shoveled from the car, the cost will be from 6 to 8 cents per ton delivered on the tender, regardless of the kind of coaling station through which it is handled. The advantages of the power plant seem to be in more independence at the coaling station, not being required to wait on switching crews, the better housing of the fuel and the ability to have large storage which can be cheaply and quickly handled. Especially important would this seem to be in winter months in locations subject to severe cold weather, when the movement of coal is often slow.

An item of importance to many roads is the ability to weigh or measure the coal to individual engines. There are four systems now in use. The first is to fill the ordinary coaling bucket which is handled on to the tender by hand or air operated crane. Second, by filling the pocket to a given mark or making the pocket of a given capacity. Third, by the balance pocket operating a dynamometer, and fourth, by having a pocket supported on scales.

Of the plans shown there are four that commend themselves as having special advantages, and would cover all general conditions: First, a cheap station operating gondola or coal cars, using the bucket as a means of measuring and transferring the coal to the tender with the air-operated crane, such as is used at many small stations on the C., C., C. & St. L. Second, the single or double pocket of large capacity, delivering coal directly to the tender or from a measured car of small capacity as shown by a station on the Erie R. R. Third, the large pocket, the total contents of which is weighed by the dynamometer, as largely used on the Northern Pacific. Fourth, the measured pocket with storage underneath and its automatic adjustment, as used on the Michigan Central. This arrangement seems an ideal one, as it admits of any extension or capacity; can be operated by drop bottom, side dump, gondola or box cars; automatically weighs the coal to measure and provides large storage capacity.

This report is signed by W. Garstang, T. S. Lloyd and W. E. Symons.

SUBJECTS.

Your committee appointed to suggest subjects for investigation by committees during the coming year, and also subjects for topical discussion at this convention, would report as follows:

For Investigation During the Year.

1. Standard specifications for locomotive driving and truck axles.
2. The purifying of feed-waters for locomotives.
3. What constitutes a good locomotive terminal?
4. The gas engine in railroad work.
5. Water scoops and track troughs.
6. Review of recent progress in locomotive designs, including boilers, wheel arrangement, cylinders and valve design, frames and machinery.
7. Locomotive boilers. The Vanderbilt boiler, wide firebox, and how much grate area is desirable to obtain the best results from soft coal.
8. Piston valves.
9. Standard pipe fittings.
10. Revision of standards of the Association. (More particularly specifications for materials).

For Topical Discussion During this Convention.

1. The proper method of lubricating locomotive driving and truck axle journals.
To be opened by Mr. G. R. Henderson.
2. What material should be used for hub liners on cast steel driving wheels and on the faces of cast steel driving boxes?
To be opened by Mr. D. F. Crawford.
3. Should side parallel rods be in position on locomotives while in transit?
To be opened by Mr. William Garstang.
4. Wanted: A design of piston follower, bull ring and packing ring for cylinders of large diameter that avoids the necessity of removal of piston from cylinder to change rings, the removal of piston on account of wear, the use of snap rings and the use of riveted followers.
To be opened by Mr. William McIntosh.
5. The best material for crank pins.
To be opened by Mr. John Mackenzie.
6. Reformation of the Motive Power Department of the average American railway.
To be opened by Mr. S. M. Vauclain.
7. The use of nickel steel in locomotive construction.
To be opened by Mr. R. Quayle.
8. The maintenance and lubrication of metallic piston rod packing.
To be opened by Mr. D. Van Alstine.

This report is signed by W. H. Marshall, chairman; S. M. Vauclain and A. J. Pitkin.

ADVISABILITY OF JOINING THE INTERNATIONAL ASSOCIATION FOR TESTING MATERIALS.

We believe more good would result from the Master Mechanics' Association urging their specialists to join the International Association individually or as representatives of the railroads than could be obtained by the Master Mechanics' Association joining as a body. It may also be advisable to recommend the appointment of a committee to co-operate with Committee No. 1 in the formulation of standard specifications applicable to material used in railroad work. Your committee recommends

First: That this Association should not join the International Association until a more definite organization is effected.

Second: That a committee of material experts, members of this Association, be appointed to consult with the International Council (American Section) if it desires our assistance.

Third: That it would be far better for this Association to adopt the specifications agreed upon by the International Council, if a majority of our members would indorse the same, instead of becoming members of the International Council, thus leaving our Association free to depart from them at any time a majority vote would favor doing so.

This report is signed by S. M. Vauclain, H. S. Hayward and T. W. Gentry.

A JOINT LIBRARY WITH THE MASTER CAR BUILDERS.

The undersigned was appointed a committee to confer with a similar committee of the Master Car Builders' Association, to consider the establishment of a joint library for the two associations. The matter has been carefully canvassed from the standpoint of both associations, and as a result of the joint deliberations, would report that it is deemed inexpedient at the present time to establish a joint library. First: Owing to the expense involved. Second: In all large cities excellent reference libraries are maintained, whose facilities are available to all. Third: There are comparatively few of our members who would be likely to avail themselves of such a library if established.

This report is signed by A. M. Waitt.

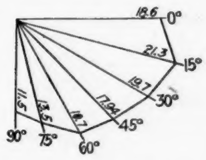
CONSTITUTION AND BY-LAWS.

It is proposed to change the constitution so that associate members, as well as active members, who have been in good standing for not less than five years, may upon the unanimous vote of the members present at the annual meeting, be elected honorary members. Other changes are that nominations must be made by the Executive Committee, and in electing officers, nominations will be made by a committee of three appointed by the President. Individual papers, approved by the Executive Committee, may be presented to the Association. All papers and reports shall be presented by abstract which shall not take more than ten minutes in the reading, unless otherwise ordered by the Association.

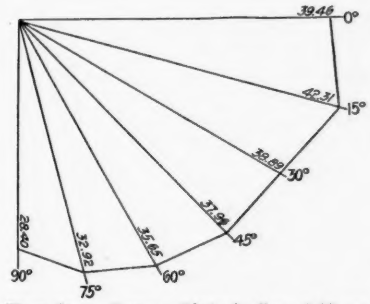
It is proposed to add to the present by-law governing discussion, so that no members in discussions shall have the floor for more than five minutes at a time, unless otherwise ordered.

Pintsch Lighting.

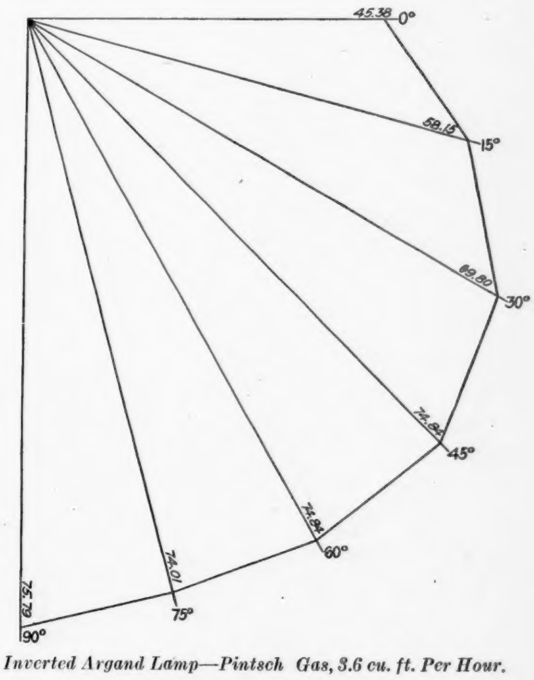
The Safety Car Heating & Lighting Company has brought out a new lamp with inverted Argand burner. This new Pintsch lamp is very efficient, as may be seen from the diagram of illumination printed herewith. This



Gordon Mitchell Lamp—City Gas, 8.1¼ cu. ft. Per Hour.



Four-flame Lamp—Pintsch Gas, 3.85 cu. ft. Per Hour.



Inverted Argand Lamp—Pintsch Gas, 3.6 cu. ft. Per Hour.

Illumination With Various Lamps.

Approximate Scale: 3/64 in. = 1 Candle.

diagram shows the efficiency in candle power of the various lamps, in planes inclined at intervals of 15 degrees from the horizon.

The active interest in car lighting for the last year appears to have done more for this old standard method than for any of the new methods that have been investigated; that is, the business of the Safety Car Heating & Lighting Company for the last year was the largest in its history. More cars were equipped with Pintsch light than in any other one year since this system was introduced in the United States.

Up to Jan. 1, 1901, the cars equipped with Pintsch light numbered 105,000 in all countries of the world. This was an increase of 14,400 cars over the total Jan. 1, 1899. The cars equipped with the Pintsch system in

those two years were more than in any other two years since the introduction of gas lighting for railroad cars.

Of course the United States was responsible for a good deal of this increase and there are now 56 Pintsch gas plants in operation in the United States and Canada and two more are building, namely, one at St. Paul, Minn., and another one at Los Angeles, Cal. Preparations are being made to put up gas works at the City of Mexico, San Antonio and El Paso.

Power Equipments for Railroad Shops.

BY GEORGE A. DAMON.*

PART I.

When Sherlock Holmes was imprisoned in a dungeon by his enemies, and was asked how he expected to escape, he answered, "There are so many ways to get out of this that I don't know which one to take," and then adopted what proved to be a very feasible plan and was soon out of harm's way. When the railroad engineer is at first confronted with the problem of supplying a modern railroad repair shop with an up-to-date equipment for heat, light, compressed air, power and water, he is in a position similar to that of the famous detective, and is generally embarrassed more by the variety of available methods than by the lack of them.

A number of railroads within the last year or so have either remodeled their old shops or have gone a step further and built entirely new ones, and a great many other plans for shops are now under consideration. In all of these an effort has been or will be made to adopt the best engineering practice in connection with the heat, light and power equipment. It is not the intention of this article to attempt to say what is the best practice in each case, but rather to cover the preliminary considerations which must be gone over carefully in reaching a conclusion as to "which way to take" in any particular problem.

Central Power Plants.—The use of one power plant centrally located may be mentioned as one and about the only one feature which has been so widely adopted by railroad engineers as to have earned the title of "best practice." This one central station is the source of the heat, the light and the power used throughout the shops. In it may be located the pumps for the water service and fire system, and the compressors for the air system. The adoption of this central station assumes from the very beginning that electricity will be the motive power. Considerable has been said and written in regard to the comparative efficiency of belt drive, rope drive, and electrical transmission, but the particular lesson for the railroad engineer to learn is that the question of efficiency of transmission enters very little into the problem. The cost of fuel for power purposes in a large shop amounts to not more than 2 per cent. of the payroll, so that any system which will allow the buildings to be laid out according to considerations of the convenience of handling men and material in order to reduce the payroll to a minimum is the system which should be adopted.

It has been claimed that some of the modern electrically equipped shops require more power than shops of a similar size with belt and rope drives, but even where this is shown the users do not hesitate to commend the electric system. A shop arrangement permitting the power required to be generated at a central point in one set of steam cylinders and then to be transmitted to any place over a large area at any time, has so many advantages that its adoption is no longer a subject for profitable discussion. We find all the more modern installations with one isolated power plant, located convenient to the coal tracks and water supply, and ordinarily, but not necessarily, at a central point.

Fig. 1 shows the general arrangement of the Oelwein (Iowa) shops of the Chicago Great Western. Fig. 2 shows the arrangement of the Fond du Lac (Wis.) shops of the Wisconsin Central. Both of these are examples of modern practice. It will be noticed that one of the main features of these particular shops is the use of one transfer table connecting all the shops and arranged to serve all the transverse shop tracks. The power house in each case is located at one side, convenient to a coaling track. From these power plants the wires for supplying electric light and power, the pipes for water, live steam and compressed air and the heating system radiate to the various buildings. At Oelwein these auxiliary connecting pipes and wires are carried in a tunnel, but at Fond du Lac they are distributed on poles and trestle work. The power plants will be described more in detail later.

Electrical Systems.—The particular electrical system to adopt is very much of an open question, to which each shop designer must give careful attention. The direct current generator and motor have been widely used and even abused, and in their more recent forms have proven to be a reliable and desirable means of transferring the power from the engine cylinder to the line countershaft, or directly to the individual machine. Direct current equipment has been developed into nearly a standard grade of apparatus, in regard to sizes, speeds and ratings, and is manufactured by a number of reliable companies, so that competition has reduced the prices and at the same time raised the quality. The inherent defect of the direct current apparatus, however, is that it requires a set of brushes and a commutator for each machine. These parts require more or less attention, and are sometimes the source of trouble.

The alternating current generators and motors have one big advantage over the direct-current equipment in that there are no sparking brushes or commutators to burn. The current-carrying conductors enter the motor through binding posts and the rotating windings have no connection with the stationary coils. There is little to get out of order, and for dirty, dusty, or inaccessible places there is not much left to wish for. The alternating current machine is a much better proposition both electrically and mechanically than the direct-current apparatus. On the other hand it cannot be said that it has any higher efficiency for shop work, while it has disadvantages in regard to regulation and limitations in connection with speed control which should be thoroughly understood before it is adopted; especially for certain kinds of work. The manufacture of alternating apparatus is still in the hands of few companies and its price has not been reduced to that of direct current machinery.

Unless the problem of transmitting power over a considerable distance is to be considered the question of whether to use the direct or alternating current system ordinarily resolves itself into the justifying of an investment. The alternating current motor is the more reliable and durable machine for most classes of shop work. The question for the shop designer to decide is whether the extra investment which it involves is money well spent.

It must be borne in mind that most railroads can use the money available for new work to very good advantage. In considering the investment in shop equipment, therefore, it is a safe position to take to require that any suggested improvement must show a saving equal to at least 20 per cent. per year on the extra investment which it involves. This 20 per cent. allows for interest, depreciation, insurance, maintenance, and a margin for profit, and is a limit none too large to satisfy railroad conditions. Some general managers require an improvement to make even a better showing before its adoption is determined upon.

Size of Motors.—The problem of making a dollar earn the most money will present to the careful designer numerous complications. In this connection fewer questions are more involved than the determination of the size of the motors. The ideal railroad shop, from an operating standpoint, has an individual motor for each machine. When the investment is considered, however, it is easy to see why the average railroad shop falls short of the ideal.

The other extreme is to provide a motor for each department. Just where the engineer will stop between these two extremes is a matter for careful study. The present practice is to arrange the small machines and those requiring a steady speed in groups driven by line shafting, each section requiring a motor of 10, 20 or 30 h.p.; some effort being made to select the size of motors so that they shall be interchangeable, and thus require a small stock of repair parts. Machines requiring more than 20 h.p., and also those machines which call for location at points inconvenient for shafting are candidates for individual motors. In certain machines such as turret lathes, radial drills, etc., where it is desirable to have a wide range of speeds at easy command, individual motors with a multiple voltage source of energy may be advisable. The tendency is more and more toward the special application of the individual motor, but the expense involved in each case should be thoroughly considered before it is adopted.

Size of Generating Plant.—In selecting the size of the generators it is necessary to make a careful estimate of the probable demand for power. This can best be done by plotting a possible load diagram which even if it be only approximately correct will be better than no estimate at all. The first difficulty is to determine on the horsepower required by each individual machine. For this purpose the shop designer will have to collect considerable data, or be guided by an educated judgment. The available information on this subject shows a wide variation in regard to the probable amount of power required to drive any one machine, but with the introduction of individual motors and electrical equipment there is being gradually accumulated more exact data.

A "load factor" is ordinarily assumed in deciding the required power of the shafting motors. This factor is the ratio between the sum of the power required by each individual machine to the probable maximum demand at any one time. This load factor will vary from 25 per cent. to 75 per cent., depending on conditions of operation. In the ordinary railroad machine shop it may safely be taken at 50 per cent., but should be higher in planing mills, and in other places subject to excessive and variable loads. No one formula, however, can be developed which will cover all the different conditions of shop operation. With two sizes of shafting motors arranged to be interchangeable there may be secured an opportunity to readjust motors after the shop is in running order. Working on the principle that if a motor is too large it will never be heard from, some shop designers have put in motors which are far too large, and have thus not only burdened the installation with too large an original investment, but have also caused a constant sacrifice to efficiency.

Other "load factors" will have to be estimated in determining the generator capacities. These factors will be different for the shafting motors, for the crane, transfer-table and turn-table motors, for the individual machine motors, for the fan motors, and for the lighting load. The final estimate should be compared to actual results as determined by the operation of shops already in operation. In dividing the generating plant into units, the controlling consideration is to select such sizes as will allow the engines and generators in operation to be loaded to about their economical rating. Ordinarily three units will accomplish this purpose. If the shops are of ordinary size it will be found desirable to install a small unit for night lighting, and for the operation of turntables and small motors upon Sundays and holidays.

Water System.—If the source of water supply is near the central power plant the supply and fire pumps are ordinarily located in the station. For this purpose a separate room, in which may also be located other auxiliary apparatus is desirable. If the water is taken from a driven well the supply pump may be either a deep well pump operated by steam or electricity, a standard type of suction pump, or the water may be raised by air. If the well is a flowing artesian well it may be surrounded by a reservoir or pump. Otherwise it is sometimes considered desirable to provide a cistern for storage to be used in case of fire or failure of the service pump. The common practice, however, is to erect a large storage

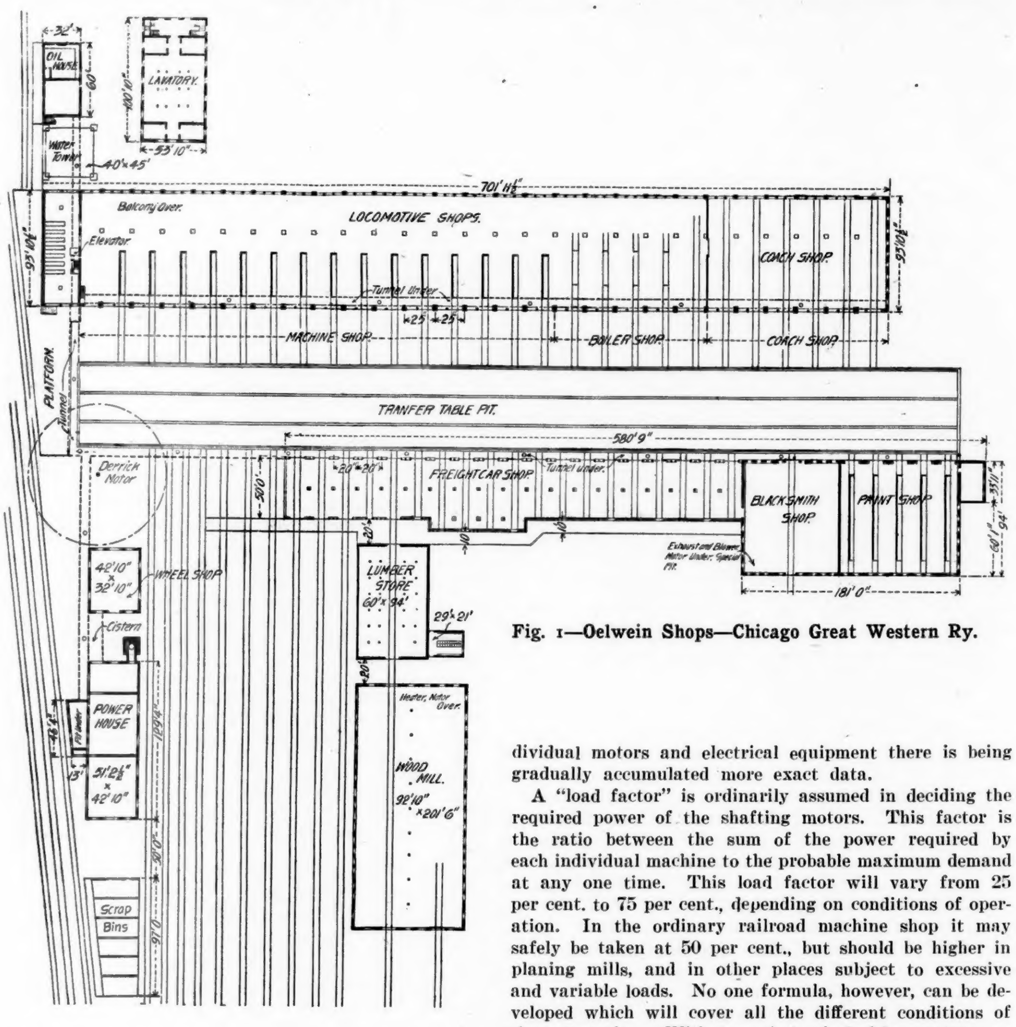


Fig. 1—Oelwein Shops—Chicago Great Western Ry.

*Engineer with Arnold Electric Power Station Co

tank, or perhaps a standpipe which is connected to the system, as in the case of a regular city water works plant. This reservoir or tower will equalize the pressure and load on the service pump and will also provide a storage for water to be used when the power plant is shut down. The connections should be so arranged with an automatic valve at the plant so that when fire pressure is put on the distributing mains the water tower is cut off. An auxiliary connection should also be arranged so that the fire pump can take water from the tower and deliver it to the hydrants. Sometimes the service pump is made with compound steam cylinders with a by-pass steam connection so that the low-pressure cylinder may be worked with steam at full boiler pressure, and thus be used as a fire pump. It is sometimes found advisable to install a separate Underwriters' fire pump.

In case the water supply is some distance from the central station, the pump can be conveniently operated by a motor. In a recent installation this motor was connected so as to be started from the main power house. A telephone receiver was mounted over the motor so that the plant operator could hear the hum of the running motor at any time, and the amount of attendance required was thus reduced to one visit a day.

Air System.—The use of electricity has so far failed to develop shop appliances which are suited to take the place of the air hoist, and the many air tools which seem to be especially applicable to railroad shops. The adoption of compressed air in shop practice shows that it has a place alongside of electricity, and its growing use should be carefully prepared for. The experience of some shops has been that the original provisions for supplying compressed air were entirely too small, and that provision for extension had also been neglected. The probable load on the air system should be studied as carefully as the requirements for electric power.

It is possible to divide the air compressors into units, each driven by an electric motor and located directly at the point of demand. This system presents a flexible arrangement which can be changed and added to at will. The motors may be connected with the electric mains through an electric controller which will automatically start and stop the motor in accordance with the demand for air. If the engines driving the power generators are large and of an economical type this system has some advantages. If the air compressor load approximates in size to the electric load, as it does in some shops, it will be found to be a better plan to install separate steam-driven air compressors in the main power plant. In such a case it takes but little figuring usually to justify an investment in high-grade, Corliss-engine type compressors.

Heating System.—With a modern shop installation it is the general practice to provide for using the exhaust from the various steam cylinders in the plant for heating purposes, and there are a number of ways for accomplishing this result. The methods of installing a piping system to heat the shops by direct radiation are well understood and information in regard to the refinements of vacuum systems to be used in connection with exhaust steam heating plants is not hard to obtain. The disadvantages attendant upon a large amount of steam pipes and numerous valves, automatic and otherwise, has led to the introduction of the blower system. When properly installed this system has been found to be satisfactory, and has met general favor. When the fans can be operated by engines so as to obtain a wide range of speed control, the system presents its most advantages. When, however, the shops are located over a considerable area, so as to widely separate the fans and heating coils a considerable distance from the power house, the piping scheme required to carry both high pressure and exhaust steam to each heating unit becomes complicated. Under such conditions the fans are usually operated with electric motors. If the shops are large this extra motor load becomes a burden on the generating plant, and may even require the investment in an extra dynamo and engine. Add to this disadvantage the fact that the system requires large steam distributing pipes which are difficult to dispose of in a satisfactory manner, and also involves some form of gravity or vacuum return system to get the condensed water back to the boilers, and it will be seen that we have another example of the fact that all good things have their drawbacks.

A system of heating with hot water is sometimes adopted. In this system the water is heated by the exhaust steam, and is then forced through the heating mains with a circulating pump at the power house. The entire system is thus under the complete control of the power plant operator. The size of pipes required for this heating system are relatively small and in laying out the piping no precautions are necessary in order to secure gravity drainage.

The limited length of this article will not permit a thorough discussion of the advantages and disadvantages of the various heating systems, and it can only be pointed out at this time that the question of heating should be among the first to be decided, as it has a bearing on the design of the power plant, and to a certain extent should be considered in laying out the buildings.

(To be Concluded.)

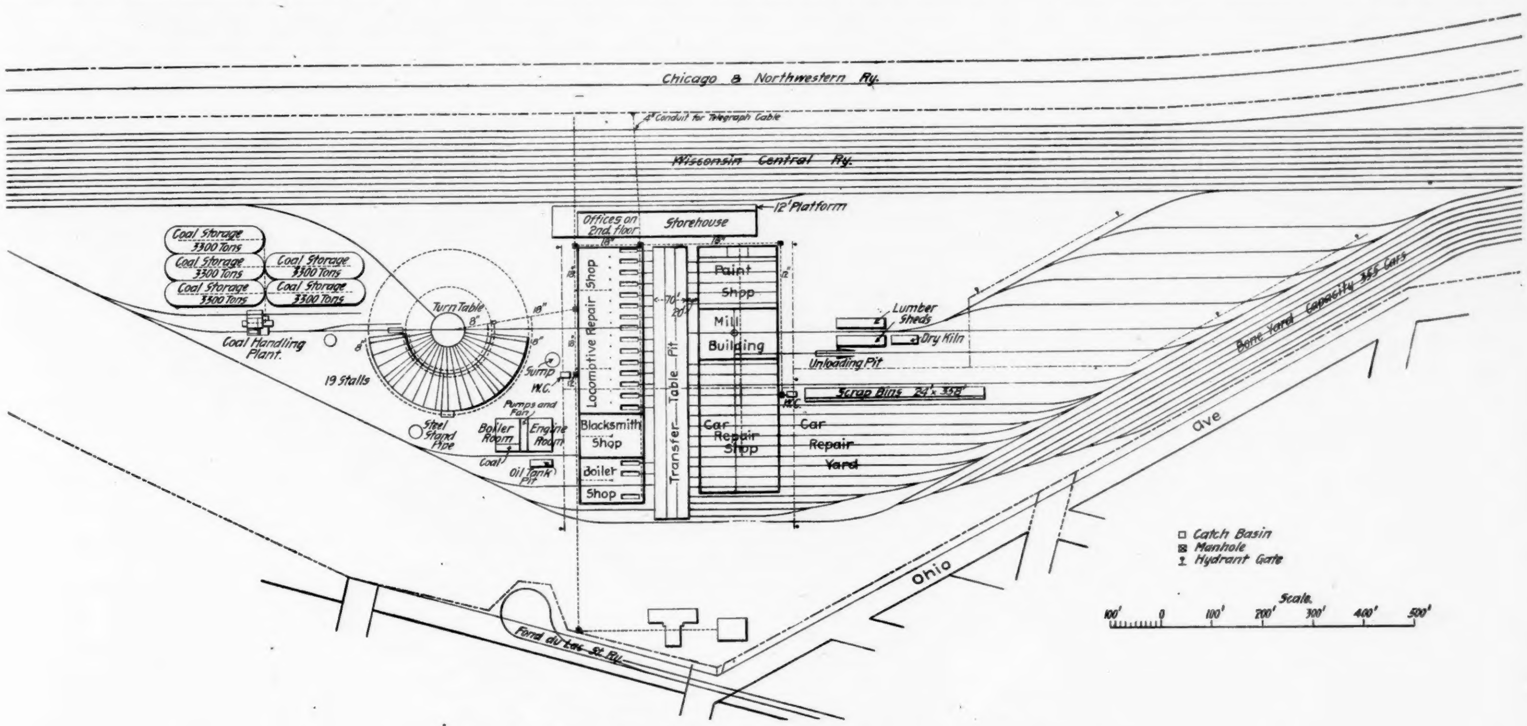


Fig. 2—Plan of the Fond du Lac Shops—Wisconsin Central Railway.

Burning Crude Oil in Locomotives.

Mr. W. N. Best, Superintendent of Motive Power and Machinery of the Los Angeles Terminal Railway, discussed the subject of burning crude oil in locomotives at the last meeting of the Pacific Coast Railway Club, and what follows is taken from his discussion.

If we first consider the burning of bituminous coal, we can better understand the subject of using crude oil, or liquid fuel. It is very important in both cases that the volatile gases should be properly consumed, for they have remarkably high heat values. Average bituminous coal contains about 65 per cent. of carbon, which has the same heat-generating qualities as coke, and 25 per cent. of hydro-carbons, which are of the nature of illuminating gases. About one-quarter, by weight, of the hydro-carbons is hydrogen gas, which makes the hottest fire possible, but a very high temperature is required to burn this gas, and if, from any cause, parts of the fire-box become too cold for converting gas into flame, it passes away unconsumed in the form of smoke or worthless uncombined gas, and makes no more heat than superfluous air. The loss from permitting hydro-carbon gases to pass away is twofold. In the first place, the heat of the burning carbon has been wasted in distilling the gas from the coal, and in the second place, valuable heat making gases have been wasted.

The combustion of one pound of hydrogen gas, if it combines with all the oxygen of the air necessary to effect perfect combustion, produces 62,000 heat units, or enough to raise about 365 lbs. of water from a tank temperature to the boiling point. The complete combustion of 1 lb. of carbon, such as rests on the grates, after the volatile gases have been liberated, produces heat sufficient to raise about 85 lbs. of water from the tank temperature to the boiling point. I give these figures to show how important it is to have all the volatile gases properly burned, and to bring us to realize the importance of always keeping every part of the fire-box up to what is called "the igniting temperature." According to Rankine, the perfect combustion of 1 lb. of bituminous coal is equal to 15,887 heat units. The perfect combustion of 1 lb. of crude oil equals 21,735 heat units. I claim that it is very much easier to make perfect combustion in oil-burning locomotives than by the improved methods of burning coal.

First, to get perfect combustion it is necessary to have a good hydro-carbon burner that will atomize the oil perfectly by the steam jet striking the flow of oil from the burner, and so atomize it that the point of ignition will not be more than 8 in. from the mouth of the burner. The arrangement should be such as to completely fill the fire-box with flames, thereby producing and maintaining a temperature sufficient to ignite the hydro-carbon gas as well as the other gases, and distribute the air which is admitted through the holes in an inverted arch to cause perfect combustion; the quantity of air admitted being regulated by dampers on each end of the ash pan.

I find that some of the hydro-carbon burners used on locomotives are entirely incapable of securing desirable results and ruin the metal of the fire-box by the force of the flame, similar to a flame made by a blow pipe. My attention was first called to a burner of this type some years past. By placing it under a stationary boiler the result was that the igniting point of oil was almost at the first bridge wall. The flame passing under the boiler, then through the 3-in. flues in the boiler and up through the smokestack, made the stack red hot, when I was compelled to change it for another type of burner. You can well imagine what great injury this style of burner would do to the crown bar bolts and flues and to the heads of rivets that join the crownsheets to the side sheets in the fire-box. The cold air is forced into the rear of the fire-box, and often a burner of this type will prove a failure, and a locomotive will smoke in spite of any efforts made by skilled and attentive firemen. In a short time a new fire-box will be required, which means unnecessary expense and creates a prejudice against crude oil as fuel. This has been especially noticeable in oil-burning locomotives, for the reason that the forced intermittent draft, caused by the exhaust of the locomotive, carries air into the fire-box in largely varying quantities. Thus at one moment there is a tendency to chill the fire-box and the contained gases and carry a portion of them off as smoke, and at the next moment to allow certain gases to suddenly ignite and be carried through the lower flue, often resulting in a series of noticeable explosions of greater or less force, and causing injury to the lower flues by reason of unequal distribution of the heat. This also causes the beads of the lower flues to become spongy and burn off, resulting in leaky flues.

The type of burner I prefer to use is one of the reverse of those used by the roads at the present time, having the oil channel *below* the steam atomizer, instead of *above* it; the advantage of this being that the oil is thoroughly atomized as it passes out of its channel, igniting the oil and gases about 8 in. from the mouth of the burner and causing the fire-box to be full of flames so that the volatile gases cannot possibly escape. It also prevents explosions of the gases or roaring in fire-boxes, and the atomizer being above the oil it cannot solidify over the mouth of the atomizer channel. By use of a proper atomizer the nose piece can be released from its position by the operation of a bridle. Should any scale from the pipe or boiler pass into the atomizer channel, in 30 seconds it can be removed by simply uncoupling the bridle, a point I consider of great value, as it insures the best results without delay. The atomizer is also provided with an automatic condensed steam release valve, which, by means of a spiral spring, is raised from its seat, allowing the condensed steam to pass out, and when the steam is turned on the burner, the press-

ure of the steam closes this valve. This device prevents water from injuring the refractory walls and arch.

I use an inverted arch, similar to those used in Russia and South America, and by railroads of California and Arizona, with this exception, that the hole for the admission of air is immediately back of the front refractory wall. By numerous experiments I found that this gives the best results, as the air is admitted at the wall against which the current of flame is forced, and the oxygen of the air is mixed with the volatile gases as the flames rise and pass under the refractory arch into the upper portion of the fire-box. Several roads use three air cavities in the inverted arch, but the two rear ones merely allow currents of cold air to pass up by the side sheets, and chill the fire-box. The inverted arch is lined with fire-brick at the rear, and around the air cavity an angle iron is riveted in order to hold the fire-bricks intact. The refractory arch consists of bricks especially designed, 9 in. thick, fitting closely to the front refractory wall and resting upon two refractory wedges, which gives them the proper pitch, the highest portion of the arch being on an exact level with the lower flue. This arch is one-third the length of the fire-box.

When I took charge of the machinery department of the Los Angeles Terminal Railway, July 17, 1899, I found the locomotives in a very bad condition, especially the fire-boxes and flues. To see an engine coming at a distance, not knowing that it was burning oil, one would have imagined that it was an old-style coal burner, by the amount of volatile gases escaping from the smokestack. Having successfully used oil on locomotives upon another railroad before being called to this road, I felt confident that by the saving of these gases I could bring about good results. By examination of the fire-boxes, I found that the same grates and grate frames were used as when the engines were burning coal, the air being admitted through the grate. The arch extended from the flue sheet to fully one-half the length of the fire-box. The arch consisted of 66 fire-bricks, which required a man five hours to build, and I am informed that often a portion of them would fall down before making a 30-mile run. One by one I took the engines into the shop and equipped them with an inverted arch and refractory wall, as described. I immediately instituted a night school of instructions for the engine men, in order that they might fully understand the proper handling of oil.

The following is a comparison of the engine and car mileage and the barrels of oil consumed by the old method of the Los Angeles Terminal, as compared with the present method, showing the results by the saving of gases:

July, 1899—	
Engine mileage	20,354
Car mileage	67,016
Barrels of oil consumed to do the work	3,050
Cost per mile for repairs	.0555
July, 1900—	
Engine mileage	21,628
Car mileage	73,881
Barrels of oil consumed	2,331¼
Cost per mile for repairs	.0222

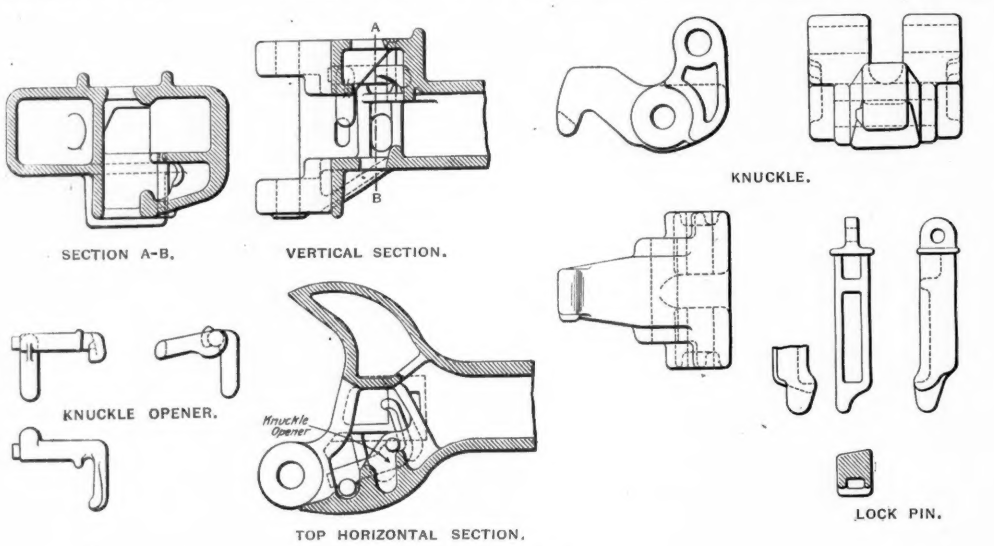
The tonnage was very much greater in July, 1900, than in July, 1899, thus making a saving of about one-third the oil. Thus it is seen that these valuable results come from a proper handling of the fuel oil.

I am confident that the railroad that will make the best record in the saving of fuel, will be the road that will give this matter the most careful attention. It should have at least one officer whose duty it shall be to instruct all engine men in the science of combustion, and who should report directly to the Superintendent of Motive Power of the road. On every division there should be a competent engine man, acquainted with all the grades of the division, whose duty it should be to instruct the engine men to properly handle the oil, and at the end of every month to report to the instructor on combustion the name of the crew making the best record in oil saving, so that due recognition by the Superintendent of Motive Power can be given them. The locomotive should be equipped with a hydro-carbon burner, on which the atomizer will so diffuse the oil that it will fill the fire-box with a volume of flame so that the gases cannot possibly escape, and one that will not discharge its steam and oil similar to a blow pipe blast against the refractory wall and sheets of the fire-box. The burning of crude oil should not be even as injurious to the metal of a fire-box as bituminous coal, for a more even heat can be attained and controlled. The cavities for admission of air, in order to supply the necessary oxygen, should be carefully examined, so that they will not fill with pieces of broken fire brick. The crude oil of 15 to 18 gravity gives the best results, is not explosive should a wreck occur, and should be as free from water as possible, as water is well known to be injurious to the refractory walls and arch.

When we first began the use of oil in locomotives in this part of the State, early in 1895, we used coils in the oil tank for the purpose of heating the oil. This was found to be a failure for these reasons: Oil of 16 gravity must be heated, and when a supply of oil was given the engine the process of heating the oil by coils was found to be too slow. A heater pipe, allowing live steam to mingle with and heat the oil, at a point near the flange connection of the oil tank has been found to give the desired results.

The Monarch Coupler.

The Michigan Malleable Iron Co., Detroit, Mich., is introducing a new coupler called the Monarch. This combines the special features of its Solid coupler, illustrated in our issue of June 10, 1898, and has the additional feature of a positive knuckle opener within the coupler head. Monarch couplers will be made in two sizes, the No. 1 coupler having the present M. C. B. standard dimensions. Size No. 2 has a deeper face of coupler, guard arm and knuckle and the width of shank is enlarged to be 6 in. sq. The strength of the No. 2 coupler is increased something more than 20 per cent. by these changes. These couplers will be furnished in either malleable iron or cast steel as desired.



The Monarch Coupler, No. 1.

The engravings show sections through the No. 1 coupler and also the details of the knuckle, knuckle opener and the lock pin. The chief claims for the coupler are that it is automatic, it has large bearing surfaces, the construction is simple and the new features are got without an increase in the number of parts. Most couplers have three positions; one where it is ready for coupling, the coupled position and one where it is unlocked. In the Monarch the coupler has but two positions; either it is locked or it is in position for locking or coupling. This avoids going between the rails to open knuckles, all operations being performed from the side of the car.

The lock is a four-sided pin with about 12 sq. in. of bearing surface on the wall of the coupler, and about 6 sq. in. of bearing surface in contact with the tail of the knuckle. These surfaces are vertical, and as the pin must be raised 4 in. before the knuckle is released it is unlikely that the parts will come uncoupled in service due to the creeping of the lock. The larger bearing between the knuckle and the pin is considered an important feature. Many couplers now in service have but a little more than 1 sq. in. of surface in contact, resulting in rapid wear of the parts. The metal in the coupler head is made to conform closely to the surface of the knuckle arm. The hook on the back of the knuckle which engages the back wall of the coupler is sufficiently strong to transmit the entire pull without the aid of the pivot pin. The back wall is double. The opening in the face of the coupler extends but a short distance toward the guard arm and when the coupler is assembled there is little opportunity for dirt to enter. The amount the knuckle can open is fixed by a shoulder on the bottom of the knuckle tail and the pivot pin is kept from turning by a cutter which is recessed in the bottom of the lower coupler lug.

With this coupler the lock set is in the head and the usual keeper bracket is not required, so there does not need to be a nice adjustment of the length of the chain. Raising the lock pin by means of the lever, the pin is set in position for uncoupling, which is a convenient feature in switching cars. In this position the pin is held up by a shoulder engaging a shelf inside the coupler head. Raised still higher a positive knuckle opener acts. This is a small casting, consisting essentially of a shaft with two arms in different planes. One arm projects into a slot in the lock pin and when the lock is lifted the full height a stop on the pin engages this arm, turning the shaft. This movement causes the opposite arm to press against the tail of the knuckle and throw it open. It will be noted that no strains are brought on the knuckle opener until after the knuckle is unlocked. As soon as the knuckle is opened and the operating lever dropped, the lock pin falls into a position ready for coupling and allows the knuckle opener to return to its normal position and out of the way of the tail of the knuckle. In this way the tail of the knuckle in closing cannot strike the knuckle opener and damage it. A retaining pin keeps the knuckle opener in place, this opener fitting the coupler head loosely. In case of a broken chain, lifting the lock pin by hand opens the knuckle and puts the parts in position for coupling, or the lock pin can be set up on the shelf in switching. It will readily be seen that a broken chain with this coupler does not cause nearly so much inconvenience as a broken chain with the common styles of couplers.

80,000-lbs. Capacity Box Car—Central of Georgia.

The accompanying illustrations show an 80,000-lbs. capacity box car as recently built by the Central of Georgia Railway Co., and which, when put in service and tested with a load of 88,000 lbs., under very rough usage, was found to fulfill the expectations of its designers. Three hundred of these cars are now being built in the railroad company's shops at Savannah and Macon, Ga. This design can be credited to no one person, as it is an evolution from the Central of Georgia 60,000 lbs. capacity ventilated car, 34 ft. long, 8 ft. wide and 7 ft. high. The first modification of this ventilated car was made by increasing the inside length to 36 ft. and the capacity to 70,000 lbs. and using a 4½ x 9-in. journal. The dimensions have now been further increased to suit the requirements of an 80,000-lb. capacity car, and the design is of more than ordinary interest in that the dimensions conform so closely to those recommended by the American Railway Association's committee on Standard Dimensions of Box Cars, as published in the *Railroad Gazette* May 3, p. 294. It will be recalled that the inside dimensions recommended by the committee are, length 36 ft., width 8 ft. 6 in., and height 7 ft. 6 in.; whereas the dimensions of this Central of Georgia car are, length inside 36 ft., width inside 8 ft. 6 in., and height inside 7 ft. 7 in., the only material difference between the two sets of dimensions being 1 in. greater height in the Central of Georgia car, and the extra height in the center, due to cutting out the carline. This gives 65.87 sq. ft. of cross-section including the extra area obtained by cutting out the carline, as against 63.75 sq. ft. in the American Railway Association's recommended car, the capacity in cubic feet of the two cars in the order named being 2371.5 and 2295 respectively. It has been considered by the designers that as this car is of 80,000 lbs. capacity and conforms so closely to the recommended dimensions, it might be preferable to a car of 60,000 lbs. capacity.

The length of car over buffer blocks is 39 ft. 1 in. and over end sills 36 ft. 9 in. The width at eaves is 9 ft. 11½ in. and the width on sills 9 ft. ½ in., the height of the running boards from rails being 13 ft. 2 in. and the height at eaves 12 ft. 1 in. The trucks are the Pressed Steel Car Co.'s diamond frame type with Pressed Steel bolsters and transoms. The bolsters are carried on two nests of coil springs, four single coils per nest, and the center plate is of ½-in. steel plate pressed to Central of Georgia standard. The wheel base of trucks is 5 ft. 7 in., the distance from center to center of trucks 26 ft. 9 in. and the total wheel base of the car 32 ft. 4 in. The side-bearings are malleable iron and the chafing surfaces are 1¾ in. above the chafing surface of the center plate. The axles are steel, 7 ft. 2½ in. long over all; 6 ft. 4 in. from center to center of journals, transversely, the body of the axle at the middle being 5¾ in. diam.

The journals are 5½ in. x 9¾ in., and without collars, the increased diameter and length over the ordinary being considered desirable as giving more area of bearing surface and longer life to the journals. It may be noted that the journals and the Central of Georgia standard journal bearing, which are here illustrated, are quite different from the M. C. B. standard. No wedge is used, the collar is turned off the end of the journal and a lip brass is used which gives ¾ in. more length. These collarless axles have been in use on this railroad for a number of years and have given excellent service, much convenience having been found in taking out and renewing journal brasses. The journal boxes are of the McCord pattern and are made of malleable iron, being arranged inside to take the M. C. B. bearing and wedge when, in emergency, it is necessary to use them. The wheels are chilled cast iron of the double plate pattern and weigh 650 lbs. each. Diamond brake-beams and Lappin's Congdon brake-shoes, inside hung, are used and each beam is equipped with two safety hangers in addition to the regular brake hanger.

The body bolsters are 12-in. steel I-beams weighing 55 lbs. per foot and trussed with two 1⅛-in. rods, the thread ends of which are 1¼ in. diam. The bolsters are packed on top with 3 in. of wood, on which the sills rest, each sill being bolted to each bolster with two ¾-in.

bolts, the top center plates and side-bearings being of the same contour as the inside of the beams and fitting snugly into them. The castings are, with one or two exceptions, malleable iron. The underframing is long-leaf Georgia pine, the six longitudinal sills all being 4¾ in. x 10 in. and the end sills 7 in. x 10 in. There are six truss rods, 1¼ in. diam. and 1½ in. at the thread ends, the two center rods passing through the buffer blocks. The end framing is very stiff, the posts and braces being 3¾ in. thick with a width of 4½ in. for the posts and 5 in. for the braces. The carlines are cut out on the under side on a curve beginning at the ends next to the side plates and running 4 in. above the bottom edge in the center. This gives a height of 7 ft. 11 in. at the center, but the inside height of 7 ft. 7 in. previously referred to is to the lowest point of carlines.

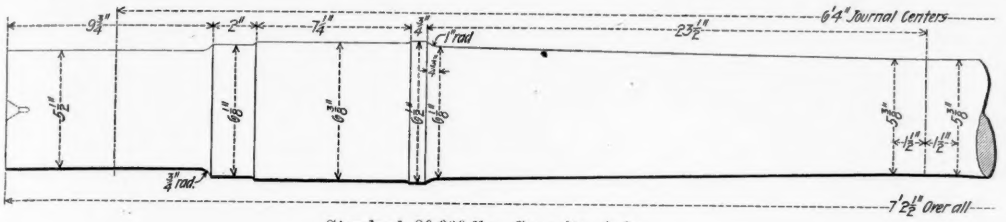
On each end, outside, is a truss rod ¾ in. diam. with a turnbuckle in the middle. This rod ends in the outside belt corner iron which, together with an inside iron, is securely strapped together with four ¼-in. carriage bolts through the framing. This prevents the end of the car from bulging. The two side plates are strapped to the end plates and carlines with 22 strap bolts, one on each end of carlines, and there is a ⅝-in. tie rod at each end of the car next to the end plate, with a turnbuckle in the middle. There are also outside and inside corner irons bolted together with four ½-in. carriage bolts through each bar. Corner irons, ¼ in. x 9 in. x 22 in., are used at the bottom corners. The nuts on all bolts used through side and end framing are on the outside of the car, leaving no projections inside, as the bolts are round-headed carriage bolts. The end and side plates are tied to the sills with 24 ¾-in. rods and four 1-in. rods, with socket washers in the plates.

The draft sills are of wood bolted to the center sills with four 1-in. bolts, each timber having a washer-plate of ⅝-in. x 3-in. iron, the full length of the timber. There are three cast-iron keys between each timber and the sills, and sub-sills 3½ in. square are bolted to the center sills to fill in from bolster to bolster, relieving the draft sills of much of the end thrust in the buffing strains. These features are fully illustrated. The couplers are of the Gallager type. Butler casements are used and the roof is Central of Georgia standard double-board grooved, each board in the bottom layer having three grooves to catch water which may come through the joints in the top layer of boards. The side door openings are 5 ft. 6 in. wide and 7 ft. 2 in. high and the end door openings are 24 in. x 32 in. The door fixtures are Jones improved, and the cars are equipped with New York air-brakes. The light weight of these cars is about 35,000 lbs.

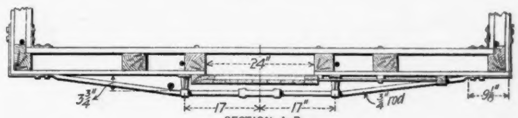
We are indebted to General Superintendent T. D. Kline and to Chief Draughtsman A. P. Wells for drawings and information from which this description is given.

Double Track Between Galion and Marion Junction.

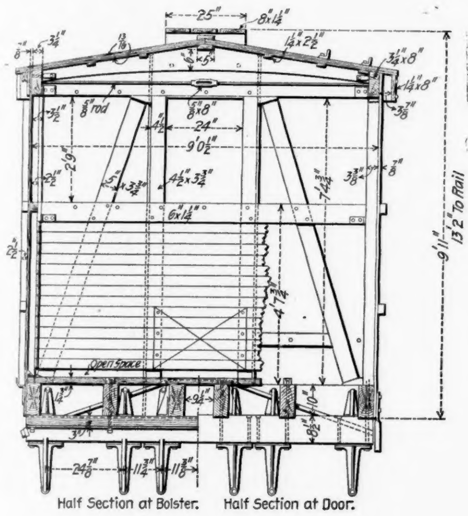
On June 9 the Cleveland, Cincinnati, Chicago & St. Louis and the Erie railroads began working their lines between the above-named places as a double track railroad, the Erie road being used by all westbound trains and the Cleveland, Cincinnati, Chicago & St. Louis by the eastbound. This line is 21 miles long and the tracks are near together all the way. The line is worked by the block system, their being five intermediate block stations. The operation of the line is under the supervision of Superintendent C. A. Allen, of the Erie. A special joint time-table is used, but the trains retain



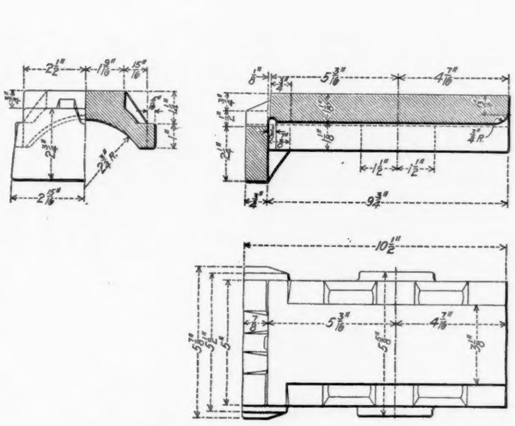
Standard 80,000-lbs. Capacity Axle.



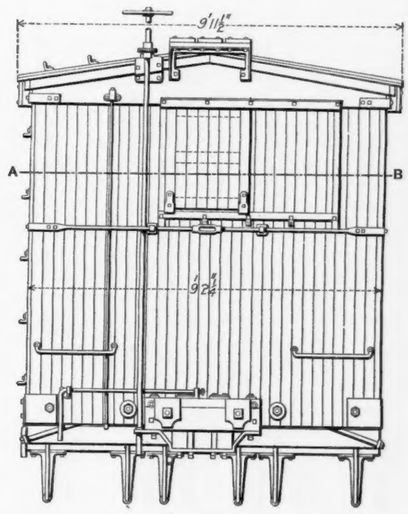
SECTION A-B.

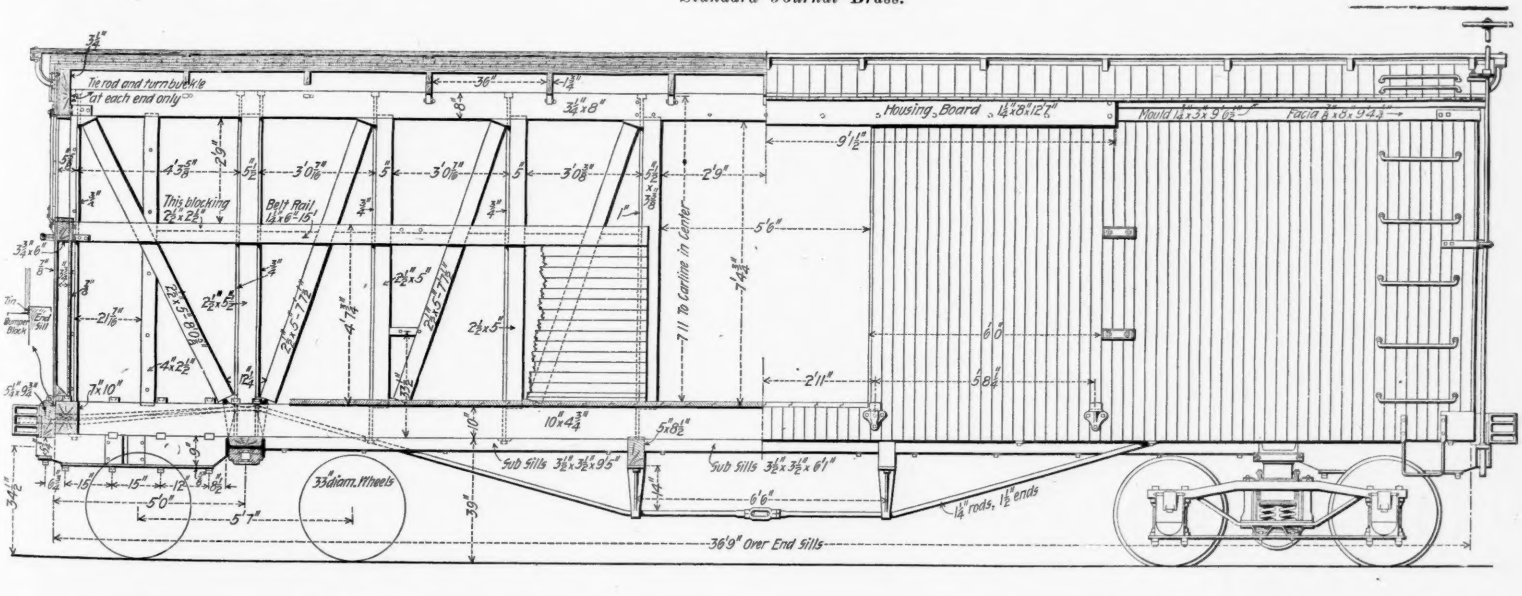


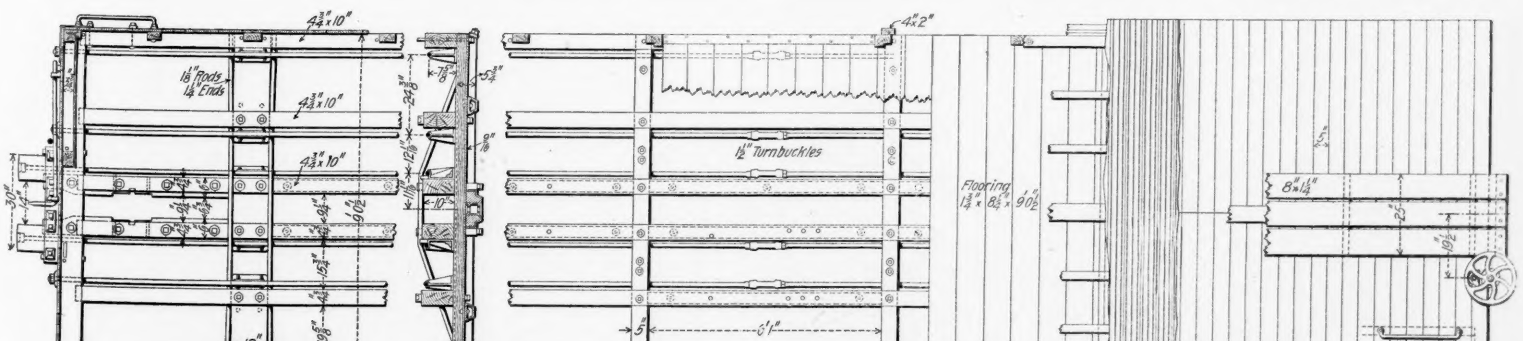
Half Section at Bolster. Half Section at Door.



Standard Journal Brass.







80,000-lbs. Capacity Standard Box Car—Central of Georgia Railway Company.

their home numbers, so that in some cases two trains of the same number run over the same track.

This is no disadvantage, as the right to the road is given to each train by the block signal, and by nothing else. The despatcher controls every movement of every train, but he gives no written orders to the trainmen; he simply telegraphs to each block signal operator, at the proper time, the word or letters instructing him whether to stop an approaching train or allow it to proceed. The following abbreviations are used by block signal operators:

D S—Display stop signal.
S D—Stop signal displayed.
B O—Block occupied.
B C—Block clear.
B W—Block wanted.
T E B—Train has entered block.

Trains are not allowed to use a crossover, except on the order of the train despatcher. Permissive blocking is not allowed except by means of train orders in regular form. If a signalman is unable to communicate with the train despatcher he may, under ordinary circumstances, give the "proceed" signal by arrangement with the signalman at the next station in advance.

The Mozier three-position signal, which is standard on the Erie's western lines, is used on the joint line. With this signal the caution indication is given by inclining the arm upward, and on the joint line this means "proceed, and clear the main track at the next siding." The night indications on the joint line are green for all-clear ("proceed") and yellow when the arm is inclined upward. The signals are fitted with yellow glasses made by the Corning (N. Y.) Glass Works. The levers in the signalman's cabin, by which he works the signals, have Mozier's patent shunt apparatus, so that whenever a signal is fastened in the position to allow a train to pass, the telegraph key is cut out, so that the signalman cannot accept an order from the despatcher to stop the train.

The Huff Auxiliary Variable Exhaust.

Much attention has been given to varying the draft of a locomotive to correspond to the demand upon the boiler, by controlling the exhaust at or near the nozzle tip. Devices having this object in view are usually operated only by manual control or are semi-automatic, as when the variation of the exhaust nozzle area is made by the movement of the reverse lever. The Huff auxiliary variable exhaust, here illustrated, is automatically controlled by the boiler pressure and can also be operated by hand from the cab. The principle upon which this device works is as follows: Between the cylinders and the exhaust nozzle tip, at a convenient point in the exhaust passages of a locomotive as ordinarily equipped in regard to the cylinders and exhaust nozzle, pipes are introduced to divert a part of the exhaust steam before it reaches the nozzle tip, when the conditions are such that the draft upon the fire is greater than is necessary. These pipes lead back to receiving and condensing drums, and the portion of the exhaust which is thus diverted is condensed there, or its excess is passed out through a vent pipe which leads from the condensing drums and is sometimes carried up over the top of the smoke arch and behind the smokestack.

The general arrangement of this device is shown in Figs. 1, 2 and 3 of the accompanying illustrations and the gate valves which control the diversion of steam from the exhaust passage are shown in two sectional views, Figs. 4 and 5. Controlling these gate valves there is a pressure valve set upon the boiler head and adjusted to open at about 5 lbs. less than the working pressure of the boiler. When this pressure valve is opened and steam is admitted to the pressure pipe shown the gate valves are raised and a part of the exhaust is diverted from the exhaust nozzle and received in the condensing drums. The reduction in draft which this action causes prevents the raising of steam pressure to the point where it would open the safety valves, and, as the boiler pressure falls from lessened draft, the gate valves are automatically closed and the full volume of exhaust again passed through the steam nozzle tip, restoring the full measure of draft to the fire. With this explanation the entire action of the apparatus is clear, and it is only necessary to say further that the same controlling action is provided for by manual operation of the gate valves by the engineer, and also that the manually operated control does not in any way interfere with the automatic action of the controlling valves. The purpose of this whole device is made clear by saying that it is adapted to close the auxiliary exhaust pipes between the exhaust passage and the condensing drums when the engine needs a strong draft on the fire, and to open the pipes when the pressure of steam in the boiler is near the maximum set pressure, and less draft is needed.

Tests in regular service have been made and a table is given herewith showing results of 12 runs of Chicago & Northwestern engine No. 339 hauling train No. 3. Six of these runs were made with the Huff variable exhaust operating, and six runs were made with the device cut out. The weather conditions, weight of train, manipulation of the engine's valve-gear, and other essential data are given, the average results for the two series of trials being shown. It appears from the figures given that the average lbs. of water evaporated per lb. of coal used was about 5.6 per cent. greater with the variable exhaust than without it, and that the lbs. of coal used per 100 ton-miles was nearly 9 per cent. less with the variable exhaust than it was without it.

This table shows that on the runs on which the variable exhaust was used there were no favored conditions and in fact that the average condition was rather unfavorable at those times as compared with the runs on which the variable exhaust device was inoperative. The variation in boiler pressure shown for the two series of tests is also favorable for the device, and from those who were present at the time that these tests were made we learn that the improved condition of the boiler as to steaming qualities was much more apparent in the observation of actual work than can be made clear in a report of this nature. To those who are familiar with road operations this statement means much, as the value of having an evenly maintained boiler pressure can hardly be over estimated, in helping toward the regular movement of trains. This exhaust is controlled by the Huff Locomotive Appliance Co., of Boston, Mass.

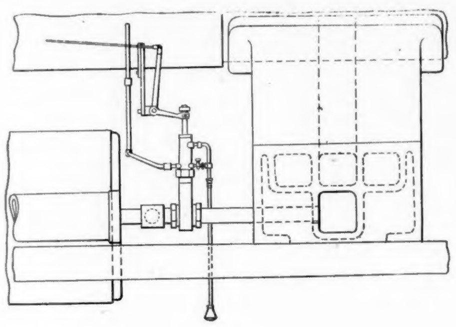


Fig. 1.

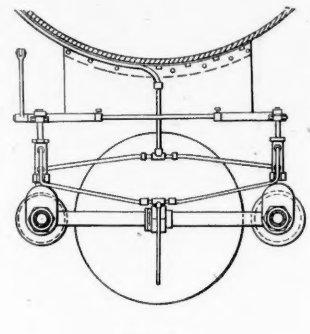


Fig. 2.

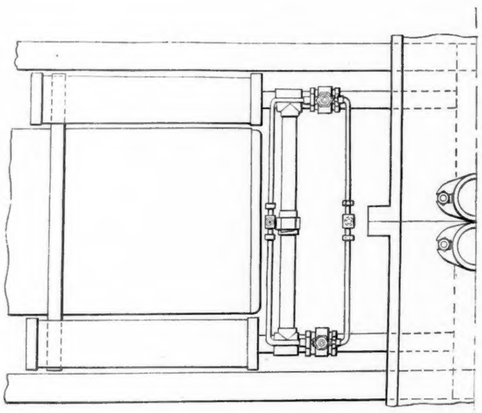


Fig. 3.

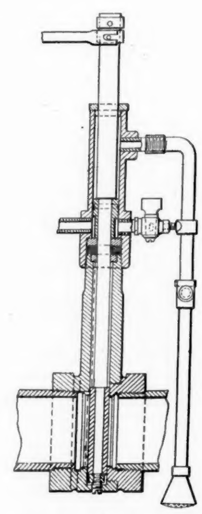


Fig. 4.

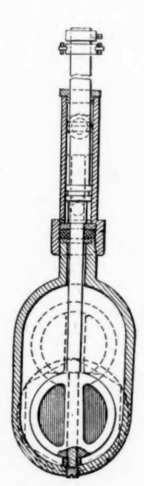


Fig. 5.

The Huff Auxiliary Variable Exhaust.

LOCOMOTIVE TESTS OF HUFF AUXILIARY VARIABLE EXHAUST.

					Train.																	
Number of Test.	Huff Variable Exhaust.	Date. 1901.	Weather.	Atmospheric Temperature.	Number of Cars.	Weight in Tons.	Regular Stops.	Extra Stops.	Slow Downs.	Elapsed Time.	Running Time.	Average Lever Position. (Notches from Corner.)	Average Throttle Position.	Ave. Vacuum in Smoke-Box. (Inches of Water.)	Steam Heat on Train.	Variation in Boiler Pressure.	Average Boiler Pressure.	Pounds of Coal.	Pounds of Water.	Evaporation—Pounds of Water Per Pound of Coal.	Pounds of Coal Per 100-Ton Miles.	REMARKS.
1	Cut out	Feb. 13	Clear N. wind	24°	8	354	11	2	2	251	227	24.5	⅜	5.6	80	160—195	180.8	13,500	68,669	5.08	27.7	
2	Cut out	Feb. 14	Light S. E. wind	21°	8	369	11	3	1	267	211	25.8	¼	6.0	80	160—195	184.8	15,950	77,464	4.86	31.3	
3	Cut in	Feb. 15	Light N. wind	29°	8	356	11	3	..	250	213	24.5	⅜	5.8	75	165—190	180.6	14,800	75,189	5.08	30.1	Water used on hot-box. W. Chicago to Clinton. Allowance made.
4	Cut in	Feb. 16	Light S. wind	34°	7	333	11	2	1	247	219	26.1	¼	4.7	70	170—195	184.4	12,800	64,678	5.05	27.9	
5	Cut in	Feb. 17	Strong N. W. wind	46°	10	438	11	2	..	270	245	24.4	⅝	5.8	65	150—190	171.8	16,300	84,449	5.18	27.0	Device cut out twice for 24 minutes.
6	Cut in	Feb. 18	Fair W. wind	24°	8	356	11	2	1	257	220	25.7	¼	5.7	70	145—195	179.7	15,300	75,468	4.93	31.2	Device cut out once for 30 minutes.
7	Cut out	Feb. 20	Light W. wind	9°	8	340	11	3	1	250	221	25.8	¼	5.9	70	160—190	181.1	16,200	73,908	4.56	34.5	
8	Cut out	Feb. 21	Fair N. W. wind	21°	9	371	11	2	..	256	225	25.2	⅜	6.2	70	170—190	181.0	16,400	77,588	4.73	32.0	
9	Cut out	Feb. 22	Light N. W. wind	13°	8	374	11	1	1	258	217	25.7	¼	5.8	70	165—190	181.0	16,400	72,037	4.39	31.8	
10	Cut out	Feb. 23	Light S. wind	27°	7	334	11	6	1	252	224	25.8	⅜	5.7	70	165—195	183.8	14,340	72,598	5.06	31.1	
11	Cut in	Feb. 24	Light S. wind	20°	8	359	11	1	1	250	221	26.0	¼	4.5	70	160—195	181.6	13,700	67,048	4.89	27.7	From Dixon to Clinton throttle opening was ⅛.
12	Cut in	Feb. 25	Fair W. wind	22°	8	379	11	6	..	268	226	25.6	⅜	5.7	70	160—190	183.5	14.450	74,969	5.18	27.6	
Average of tests with Huff variable exhaust cut out				19°	..	357	..	..	..	256	221	..	..	5.9	..	......	182.1	15,460	73,711	4.78	31.4	
Average of tests with Huff variable exhaust cut in				29°	..	370	..	..	..	257	224	..	..	5.4	..	......	180.2	14,560	73,634	5.05	28.6	

NOTE.—All tests run with Jackson Hill coal.
Engine.—Piston valves; 20 in. x 26 in. cylinders; 4⅞ in. nozzle.

Cut-off....	24th notch	8¼ in.
	25th notch	6¾ in.
	26th notch	6¼ in.
	27th notch	5 in.

Manganese Bronze Staybolts.

When the Northern Railroad of France put in service locomotives carrying 199 and 213 lbs. pressure per square inch serious difficulties quickly ensued, caused by the frequent breakage of copper staybolts. M. du Bousquet, Chief Engineer of Material and Traction of the company, started a thorough study of the question and prepared for each engine diagrams showing the side sheets, tube sheets and back sheets, respectively, of each fire-box (see Figs. 1 to 4). Indicated on these diagrams were all breakages of staybolts which occurred in service. Each staybolt was shown by a cross, and broken staybolts by a circle. When ruptures occurred repeatedly at one place the circles were repeated as many times as the break recurred.

Furthermore, in order to eliminate as far as possible local and special causes the central office prepared diagrams similar to the above, but on squared paper ruled to centimeters and millimeters, each square centimeter representing one staybolt. Whenever a broken staybolt was found in any locomotive of the series under consideration one square millimeter was blackened in the area of the square centimeter which represented that particular staybolt. Thus was constructed a diagram which showed immediately the places where ruptures occurred oftenest on the whole group of engines. Figs. 5 to 8 show these diagrams up to Oct. 15, 1900.

From these we see that the three upper rows of staybolts in the side sheets and the back sheet of the firebox suffered most and that next after these were the staybolts found near the angles and under the firebrick arch.

The question being localized in this way, M. du Bousquet prescribed a series of trials bearing on the form and material of staybolts. Up to that time he had used staybolts threaded their whole length and trial was made now of staybolts threaded only at the ends, as in Fig. 9, in order to get rid, as far as possible, of chances of rupture due to threading. No notable improvement was observed.

The question of increasing the diameter of the staybolts which seemed to be most fatigued was then considered, but as the ruptures are generally due to unequal expansion of the outside and inside sheets this remedy was not efficacious. In fact, when we consider the shape that a staybolt must take when the two sheets expand unequally it has seemed that the larger the diameter the greater is the work done by the staybolt in conforming to these changes. (See Fig. 10.)

Another line of experiment was then begun, making use of other metals than copper, particularly iron and soft steel. It was proposed to use iron staybolts with the body of the bolt reduced in cross section, as shown in Fig. 11, the long axis of this section being placed horizontal; that is to say, perpendicular to the direction in which the greatest deformation would take place. It was hoped thus to diminish the molecular work in the section, but the results did not meet the expectation and the trial was not extended.

The use of soft steel was quickly given up, the number of ruptures did not seem to diminish with this material and a new difficulty appeared. It was found that the staybolt holes in the sheets deformed more, and more rapidly, than with copper staybolts. Trials of nickel steel gave no better results.

It was thought for a time that the breakages might be attributable to a low quality of copper and various investigations were made along this line, but with no success.

In April, 1896, M. du Bousquet received a report on a metal called manganese bronze, the physical properties of which seemed to him to deserve serious attention, and reports of experience with it indicated that it might well be employed for staybolts. Physical tests with this material, hot and cold, gave the following results, which were very encouraging:

Pulling tests were made on specimens 0.59 in. diameter and 3.94 in. long between the shoulders of the specimens. In the cold test the mean resistance to breaking was at 44,945 lbs. per square inch, with an elongation of 39.4 per cent. At 100 deg. centigrade the breaking strength was 47,079 lbs. per square inch, elongation 34.9 per cent.; at 200 deg. centigrade (392 deg. F.) breaking strength 44,234 lbs. per square inch, elongation 34.2 per cent. Drifting tests showed excellent quality, as did bending tests. The results showed that this manganese bronze was notably superior to copper in the cold tests and incomparably superior in the hot tests, for copper at 200 degrees centigrade breaks at 22,330 lbs. per square inch, the elongation being about 34 per cent.

In 1896 the first use of these manganese bronze staybolts began. At first they were used to replace copper staybolts on the first three horizontal lines on the top of the side sheets of certain compound high-speed locomotives. The same application was later made on about 20 passenger engines, the delivery of which was begun in September, 1898. Later it was decided to replace with manganese bronze all broken staybolts in these engines, and finally in March, 1900, a fire-box was completely fitted with these bolts. Engines No. 2641 and 2642, carrying a working pressure of 227.5 lbs. per sq. in., the latter one of which was shown at the Exposition and the former of which was put in service April, 1900, are also completely equipped with manganese staybolts. Further, the Northern Railroad of Belgium has received from the Cockerill Works six passenger engines completely fitted with manganese bronze staybolts. These are compound engines, two driving axles coupled, carrying 213 lbs. per sq. in. working pressure.

To sum up, the first application of manganese bronze staybolts began in 1896. Since that time some 3,500 have been put in service, most of them in those parts of the fire-boxes which had been found subject to the most frequent breakages of staybolts. Up to the 10th of December, 1900, not one of these staybolts had been found broken.

To give an idea of the importance of this result the following figures were cited: In the first three months of 1897 the breaking of copper staybolts was at the rate of 543 per month in 40 locomotives under observation. In the first three months of 1898 this average had fallen to 379 per month; in the first three months of 1899 to 148, and for the first three months of 1900 to 99. It will be remembered that in some of these engines (the article from which the translation is made does not make quite clear how many, but probably in most of them) manganese bronze staybolts had been introduced in those parts of the fire-box most subject to broken staybolts.

Encouraged by these results, the Northern Railroad of France intends to use fire-box tube sheets of manganese bronze, but the makers of the material are not yet ready to deliver pieces so heavy. Furthermore, this metal seems eminently adapted to making tubes in which steam circulates at high pressure, notably for water-tube boilers.

In all of this the name "manganese bronze" has been used for this metal, this being given to it by the maker, but this name seems subject to some criticism for analysis has discovered in the metal only copper and manganese, this latter being present to the amount of about 4 to 3 per cent.

Finally it may be well to mention another trial which has been made on the Northern Railroad. This is of staybolts made of "Stone" bronze, which seems to have given excellent results in England. These "Stone" staybolts are of special composition and they have, moreover, four slots cut in them, as shown in Fig. 12, designed to give great flexibility. About 130 of these staybolts were put into service in 1898 on a compound locomotive carrying 199 lbs. working pressure. No rupture has yet appeared.

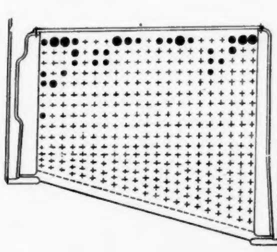


Fig. 1.—Left Sheet.

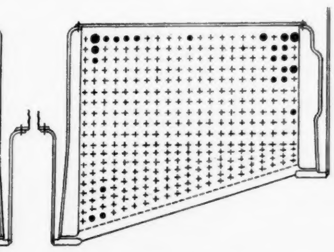


Fig. 2.—Right Sheet.

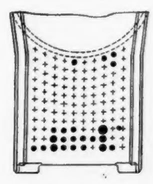


Fig. 3.—Tube Sheet.

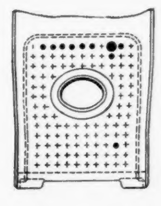


Fig. 4.—Back Sheet.

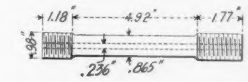


Fig. 9.

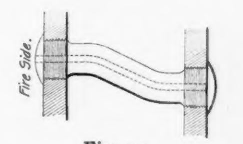


Fig. 10.

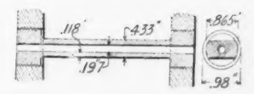


Fig. 11.

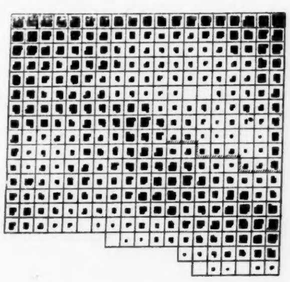


Fig. 5.—Left Sheet.

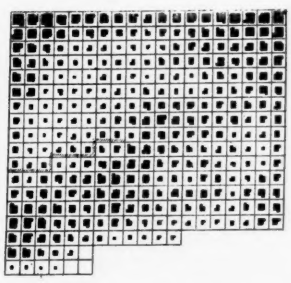


Fig. 6.—Right Sheet.

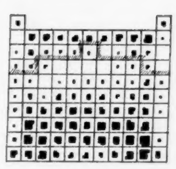


Fig. 7.—Tube Sheet.

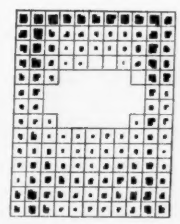


Fig. 8.—Back Sheet.

Fig. 12.

The Friction of Brake Shoes.

BY R. A. PARKE.

(Concluded from Page 408.)

The Physical Aspect of the Subject.

It is not without regret that the writer has felt the necessity of thus criticizing the published results and deductions from a series of experiments which have involved much gratuitous labor and have received commendation. The very fact that the views and conclusions expressed in the Railway Club paper appear to have been hitherto accepted without challenge, attests the importance of unmistakable dissent, if the views and criticisms herein expressed are well founded. The character of recent brake-shoe friction investigation seems to tend toward demoralization of the subject. From the meager accumulation of apparently contradictory information upon the subject, is it not possible to discover a rational solution of apparent inconsistencies, to assign satisfactory reasons for obscure phenomena and to outline a method of future investigation which, even if tedious and uninviting in its aspect, shall systematically lead to a clear, ultimate knowledge of the subject? The object certainly justifies the effort and the remainder of this contribution will be devoted to that purpose.

Scope and Character of Experiments.

The first logical step in an examination into the subject as it stands, is to seek reasons for the various characteristic peculiarities of the friction line, since such reasons may shed light upon the best method of investigation. The most promising explanations of the cause of fluctuation of the coefficient of friction with variations of pressure and of speed, have already been considered. Investigation of the effect of different degrees of pressure should obviously be made through experiments in each of which the speed is constant, in order to avoid the confusion arising from the simultaneous operation of a variety of undetermined influences. It is necessary to make tests for each of quite a wide range of pressures, separated by moderate intervals, from very light to the heaviest of practical service, at each of a wide range of speeds, similarly differing by moderate intervals, from bare movement to the highest of customary service, and that each such test shall be repeated a sufficient number of times (probably not less than ten) to equalize and eliminate the accidental effects of irregularity of texture and lack of homogeneity of the materials and to thereby yield average results of a reasonably representative character. This implies several hundred (probably about 1,000) experiments with a single kind of brake shoe upon a single kind of wheel. It is by no means to be understood that all these experiments should be conducted for the purpose of determining the relative merit of each different kind of brake shoe; but it is essential to have this entire range of information in order to determine with sufficient accuracy the laws of brake-shoe friction, and no trustworthy conclusions can be definitely formulated through means involving less patient labor. Each of these contemplated tests will necessarily be complicated by the decrease of the coefficient of friction accompanying continued rubbing, and must therefore be continued until the friction line has found a practically stationary level. Such a system of tests should suffice to determine the law of variation of the coefficient of friction as influenced separately by variation of pressure, variation of speed and continued rubbing, and should also furnish adequate data for determining the law of variation under the combined influence of variation of pressure and continued rubbing. It may also present the necessary information to define the law of variation of the coefficient of friction when continued rubbing is coincident with variation of speed; or, in other words, it will supply at least part of the information necessary to determine the coefficient of friction at any instant during a stop, when data is given concerning the brake-shoe pressure, the speed at the instant, and the distance through which the shoe has theretofore rubbed upon the

wheel; but, to be trustworthy, any conclusion of this character must be confirmed, and probably modified, through a supplementary series of stop tests made with different constant brake-shoe pressures and initial speeds, where continued rubbing is actually accompanied by variation of speed. It need hardly be added that the data supplied by these series of tests can only be formulated into conclusions of value and utility by the aid of keen mechanical and scientific judgment and expert mathematical analysis. What is required, in the present state of our knowledge of the subject, is not satisfied by indefinite statements of the general characteristics of brake-shoe friction, but must be a sufficiently accurate, immediately applicable system of data which shall lead us, by means of proper analysis, to determine just what is occurring while the brakes are applied to a railroad train, and to thereby enable us to discover measures for attaining higher brake efficiency. Further advance in the art of efficient train braking depends perhaps more upon this than upon any other line of investigation.

The Initial Rise of the Friction Line.

Next to the effects of varied pressure, varied speed and continued rubbing, and apparently closely allied with them, the subject of importance is the nature and cause of the gradual though rapid rise of the friction line at the very beginning of each application of the brake shoe to the wheel. This characteristic feature of the friction line was clearly distinguished in the Westinghouse-Galton experiments. As the brake shoe was applied to the wheel in these experiments by means of the air-brake apparatus upon a railroad vehicle in actual, practical operation, this phenomenon was very naturally attributed to the element of time required to secure the full air pressure in the brake cylinder. In the experiments upon the Master Car Builders' testing machine, the full brake-shoe pressure was instantly applied by gravity, and the cause assigned by Captain Galton for the phenomenon is therefore insufficient. Although the published diagrams taken from the testing machine clearly indicate vibration of the recording pencil during the initial rise of the friction line, the character of the vibration appears to be much the same as that occurring, to a greater or less degree, throughout the remainder of the diagrams, and implies the effect of inertia of the recording mechanism rather than any rebounding or vibration of the weighted lever by which the shoe is caused to press upon the wheel. Moreover, the weight drops through too short a distance to set up a serious disturbance of a vibratory nature. As the phenomenon occurs under these conditions as well as those of the Galton experiments, we are confronted with the question, "what is the cause of the peculiarity?" An examination of the published diagrams taken from the Master Car Builders' machine seems to indicate that quite a uniform interval of time elapses, throughout the wide range of initial speeds of the stops from which the diagrams were taken, in bringing the friction line up to its initial maximum, and the most plausible cause to be suggested for the phenomenon seems to be a wide fluctuation in the distribution of pressure during this early period.

A condition that must have in general existed during the experiments to determine the influence of pressure upon the coefficient of friction, is that the pressure was practically uniformly distributed over the face of the shoe, the projected area of which, perpendicular to the direction of pressure, is a certain number of square inches. A statement of the relation between the coefficient of friction and pressure may thus be properly expressed in the form that the coefficient of friction varies inversely as the pressure per square inch of the projected rubbing surface. This is a very important distinction, inasmuch as there is abundant reason to believe that the coefficient of friction would have quite different values if the same pressure were applied to two shoes of materially different rubbing areas, under conditions otherwise identical. It is well to add, however, that it is probably true that the relation between the coefficient of friction and the pressure per square inch is not identical with shoes of different size. There may be more than one reason for this, but there is at least the one that the structure of the cast iron in the shoe is different at the interior of the surface from what it is near the edges, and therefore there are different relative amounts of metal in different structural conditions in shoes of different shapes and areas, and also there is a different relative length of hard scale surrounding the surfaces at the periphery. So far as brake-shoe friction in general is concerned, this feature of the matter requires comparatively little consideration, because of the very general use of brake shoes of standard dimensions. It is obvious, however, that, in order that correct and useful data may be secured, experiments must be conducted only with brake shoes having the exact form of those employed in practice, to which the investigation is intended to apply.

Returning now to the friction line at the beginning of each brake application, it will be readily understood that, at the end of each experiment, a condition exists in which the surface of the shoe conforms to the surface of the wheel and in which the surface is materially hotter than the back of the shoe. As the shoe subsequently cools, the surface contracts more than does the back, so that, when a uniform temperature is reached, its form becomes distorted. When the shoe is next applied to the wheel, only a portion of the surface of the shoe (undoubtedly the portion near the two ends) comes into contact with the wheel. The application thus begins with a very high pressure per square inch upon only a portion of the surface, near the ends of the shoe, which results in a correspondingly low coefficient of friction. The pressure per square inch declines as contact gradually extends from the ends toward the center of the shoe and the pressure becomes distributed over a larger area, resulting in a corresponding increase in the value of the coefficient of friction. The gradual conformation of the surface of the shoe to the wheel would result from the expansion due to the heating of the surface and from gradually yielding to the pressure. If this theory is well founded, it seems probable that the initial maximum value of the coefficient of friction will occur more quickly with shoes worn thin than with those of nearly their original thickness, because of both the greater spring of thin shoes and the smaller difference of the temperatures at the surface and at the back of the shoe at the stop to cause distortion upon cooling. This feature of the friction line is certainly of sufficient importance to merit careful investigation. The series of tests which have already been outlined for other purposes will afford also the means of such an investigation. While the influence of this characteristic feature upon the length of stops is comparatively small for stops from the higher initial speeds, it becomes an important factor in stops from low initial speeds. It may, in passing, be stated that its influence is chiefly responsible for the fact, announced in the Railway Club paper, that the mean coefficient of friction is found to be lower in stops from an initial speed of 10 miles than in stops from an initial speed of 20 miles per hour.

It is very important to observe that, while the character of this initial rise in the friction line is probably a function of both time and speed in tests upon the Master Car Builders' machine, the case is probably different in actual practice where the pressure is applied by the air brake, and the rate of application of the pressure is a function of time alone. The character of the rise in the friction line is thus likely to be different in the two cases, and especially if the time required to charge the brake cylinder with its full air pressure is greater than the time necessary to secure the initial maximum in the friction line in experiments upon the testing machine. In that case, the rise in the friction line in actual practice may probably be expressed as a very simple function of time, and, in addition, the complication which might otherwise be introduced by variation in the thickness of the shoe, may be expected to be largely eliminated. It is very desirable and important, therefore, that the method heretofore employed for applying the pressure in the use of the testing machine should be replaced by one involving the precise character of pressure application that occurs through the use of the air brake in actual practice.

Cause of the Decline Through Continued Rubbing.

We now come to an inquiry into the cause of that most interesting feature of the friction line, the decline which immediately follows the attainment of the initial maximum. There are several views which might have more or less bearing upon this matter, and, since no very definite conclusions in regard to the matter seem to have ever been reached, it may be worth while to consider each separately. It has been suggested that the phenomenon may be due to the existence of a comparative roughness of the surfaces of the brake shoe and wheel, when first brought into contact, which is subsequently worn off and the surfaces brought to a condition of polish. Under the existence of very light pressures, or in the case of very great speeds, this view might seem to have some weight; but, considering the very notable abrasion of the shoe under the conditions of ordinary service, the idea that the surfaces acquire anything like a polished condition during the application, seems to be wholly untenable. The tread of the wheel is doubtless in a much more highly polished condition, through continuously rolling upon the rail, at the commencement of an application than it could be at the close. Moreover, the report of the experiments upon the testing machine states that the surface of the wheel was smoothed by the use of sand or emery paper before each test. In view of these considerations, this explanation of the phenomenon may be dismissed as altogether unsatisfactory.

Another view which has been suggested is that the abrasion of the shoe results in the presence of rolling particles of metal between the surfaces, which operate to diminish the friction. While this view may be a correct one under some conditions, it hardly seems to offer an adequate explanation of the matter under consideration. The essential peculiarity of the phenomenon is a decline from the initial maximum value of the coefficient of friction, which is rapid at first but continually grows less rapid until, after a considerable time, the decline ceases (the speed remaining constant, of course). The rolling particle theory necessarily implies the presence of the rolling particles as soon as abrasion begins. This, in turn, merely implies that friction with abrasion should be less than friction without marked abrasion, when the influence of the rolling particles is absent. Such being the case, the friction line would simply rise to its maximum (which maximum would be limited by the presence of the rolling particles) and would there remain constant. Whatever influence rolling particles may exert, therefore, their presence cannot alone be sufficient to explain the phenomenon.

Still another explanation, which might be suggested, is an extension of the view assigned as at least a partial cause for the gradual initial rise of the friction line. That view consisted of the effect of the gradual conformation of the surface of the shoe to the periphery of the wheel, beginning with contact near the ends of the shoe and extending toward the center. This extension of contact would be due to three principal causes, namely, gradual yielding to the pressure, wearing away of the shoe surface from the ends more than at the center and excessive linear expansion at the surface, from the ends toward the center, due to the high superficial temperature which almost instantly follows frictional contact and which requires time for conduction into the interior of the mass of the shoe. When now the shoe has at last become fully conformed to the surface of the wheel, the initial maximum of the coefficient of friction should occur; but this condition may be followed by further expansion of the surface, more especially near the center which has more recently come into contact with the wheel, and accompanied by a gradual separation of the surface of the shoe from the wheel, beginning at the ends and working toward the center. This would imply a gradual increase of pressure per square inch of the surface remaining in contact and a corresponding decline of the coefficient of friction.

This explanation might thus seem quite acceptable and it perhaps would be were it not that still further extension of the same view to its ultimate conclusion seems to demonstrate its insufficiency for the purpose. Following the course of the operation of this cause from the point already reached, it seems clear that, as the shoe continues to bear upon only a portion of its surface near the center, its surface will again begin to more completely conform to the wheel, both because of wearing away near the center and of cooling and contraction near the ends, until finally, though possibly only after one or two more succeeding partial deformations, the shoe becomes fully and permanently conformed to the surface of the wheel. Thus, after the friction line has declined from its initial maximum to a certain minimum position, it will (the speed remaining constant) rise again, though perhaps not regularly, until finally its initial maximum is again reached, where it will remain permanently. This, however, does not agree with experimental observation. In the Westinghouse-Galton constant speed experiments, the decline from the initial maximum was continuous, though apparently tending toward a minimum limit, and some of the observations extended through a period of twenty seconds. The time required for the friction line to reach the initial maximum is very limited, apparently less than two seconds in every case where the full pressure is suddenly applied, during which the initial conformation of the shoe to the surface of the wheel must, according to hypothesis, take place. It is not conceivable that a subsequent deformation and reconformation, through the same cases, should not have been completed long before the completion of a period of twenty seconds. Whatever part such possible deformation may play, therefore, in contributing to the decline from the initial maximum value of the coefficient of friction, it cannot of itself account for the phenomenon.

What then is the actual cause? The views already discussed in this connection are, of course, purely speculative, except as to the fact that the brake shoe, having become cold after an application, does not at first conform to the surface of the wheel when next applied, which is known to be true from observation. But there is surely some definite, substantial cause for the phenomenon. What is it? If we return to the fundamental cause of frictional resistance, we find that, for a given area of surface and pressure per square inch, the degree of that resistance is measured by two things; one is the degree of interlocking of the particles composing the surfaces, or the extent to which the surfaces become imbedded in one another; the other is the tenacity with which the interlocked particles resist abrasion or removal. Both these matters are inherent structural characteristics of the materials composing the surfaces. Under the same conditions, surfaces of the same homogeneous materials should always offer the same frictional resistance to the same kind of motion. If that resistance varies, it can only be because of some structural change of one or both of the materials forming the respective surfaces. If we may assume that, when the initial maximum of the friction line is reached, the whole surface of the brake shoe is in contact with the surface of the wheel and thereafter remains so, then, if, with other conditions remaining constant, the friction declines, there can be no doubt that it is due to a change in the structure of the material of either brake shoe or wheel, or both. With this apparently unassailable conclusion as a basis of inquiry, we have merely to meet the question, "what operative agent can be present under such conditions which is capable of altering the metal structure at or near the surface of the shoe or of the wheel?" There is but one answer, which is heat alone. The investigations of the writer long ago brought him to the conclusion that heat is the chief cause of the phenomenon under consideration, and, from all known experiments and sources of information upon the subject of brake-shoe friction, he has found nothing with which the conclusion actually conflicts. Although the apparent hopelessness of determining the temperature or structural condition of the actual rubbing surface of a brake shoe practically precludes the possibility of experimental confirmation, the following theory is tentatively advanced.

The Effect of Heat.

During an application of the brake shoe to the wheel, each peripheral portion of the wheel surface successively rubs for a brief instant upon the brake shoe and then, for a comparatively long succeeding interval, is exposed to the action of the atmosphere. During the brief interval of rubbing, the surface particles of the wheel are highly heated, chiefly by friction, but considerably also through conduction from the immediate surface of the

shoe, and the interval of time is too short for the conduction of more than a fraction of the acquired heat into the adjacent metal of the wheel before exposure to the atmosphere occurs. During the succeeding interval of exposure, time is given for conduction of some of the heat into the interior of the wheel tread, and for radiation and conduction of the major portion of the heat into the constantly changing atmosphere, before the surface particles again come into frictional contact with the shoe. The accumulation of heat in the wheel tread, therefore, occurs but slowly, and no material change in the structure of the metal at or near the surface can be supposed to take place. With the shoe, the conditions are very different. The rubbing at its surface constantly continues; the rate at which heat is generated is exceptionally great; and this heat cannot escape, except as it is conducted away by the surface of the wheel and by the removed particles of the surface which are torn away and discharged into the atmosphere, and can be carried by conduction into the interior of the shoe. The heat thus accumulates with great rapidity, first at the immediate surface and gradually extending a short distance inwardly from the actual surface, until its effect is to bring the metallic particles into a semi-plastic condition in which they are more easily detached—a condition, in its effect, approaching that of partial lubrication. It is not unlikely that the earlier stages of this transformation of the metal structure occur before the initial maximum value of the coefficient of friction is reached, so that that maximum is itself less than would otherwise have been the case. The most pronounced effect of such a structural change would appear as soon as a sufficiently high temperature of the particles in immediate contact is reached, and the progress of the effect would decline in intensity as a corresponding condition is reached in particles more and more remote from those in actual frictional contact. Because of the considerable quantities of sensible heat which are removed, both by being carried away by the surface of the wheel and by being absorbed in doing the work of changing the structural condition of the constantly wearing and freshly presented surface of the shoe, the heat accumulation necessary to alter the structure of the particles of the shoe somewhat remote from the actual surface, but still near enough to have an influence upon the difficulty or ease with which surface abrasion is effected, requires a very material element of time. In consequence, the coefficient of friction begins to decline rapidly but the decline continually decreases in rapidity. Moreover, as the friction declines, the supply of heat is correspondingly reduced, and when the temperature of the metal near the surface has become high, the conditions have become favorable to a more rapid rate of conduction of heat into the interior of the shoe, so that a condition of equilibrium between the rates of supply and removal of the heat is approached, after which both the surface condition of the shoe and the coefficient of friction should be expected to remain practically uniform so long as the speed is unvaried. It may be that the condition of equilibrium is not simultaneously reached in all portions of the surface of the shoe; it may happen also that the process is complicated by contemporaneous changes in the conformation of the figure of the shoe; but a condition of approximate equilibrium in all respects would ultimately occur. In stop tests, where the speed continually declines, accompanied by the corresponding tendency of the coefficient of friction to increase, the rate at which the condition of equilibrium above described is approached would probably be modified, and it may even occur that such a condition of definite equilibrium does not actually exist in even the longest stop. The increase of the coefficient of friction with declining speed necessarily implies an increase of the heat supply; but the slower speed implies increased time for conduction and consequent dissipation of the heat, so that there is at least some degree of tendency of the two influences to offset one another. To what extent, therefore, the law of the decline of the friction line through continued rubbing may be functionally dependent upon the separate and combined influences of pressure, speed and time or distance, it would be hardly even interesting to conjecture, satisfactory conclusions being only possible through proper careful investigation.

Some years ago, Mr. P. H. Dudley submitted the surfaces of some cast-iron brake shoes, just as they appeared, when cool, after a brake application, to microscopic examination. He found what appeared to him satisfactory evidence of at least a partial flow of the metal upon the rubbing surface. This testimony from one so expert in the ultimate structure of iron and steel, is not without significance in support of the writer's view. Beyond evidence of this character, it seems most probable that the theory must rely upon the aggregate correctness of the various physical conclusions upon which it is based. There are two features of the temperature tests reported in the Railway Club paper, however, which may seem to imply a contradiction of the views advanced, and they require brief consideration. The first is that the initial rise in the temperature line, as shown by the recording apparatus employed, is generally immediately followed by a very marked decline, and it sometimes occurs that, at a later period, there is a second rise, followed, in some cases at least, by a second decline. In one of the experiments with a hard cast-iron shoe, the initial recorded rise takes place during the second thousand feet of rubbing and the subsequent decline chiefly occurs through the third thousand feet. A second rise occurs just after the completion of two miles of rubbing and is immediately succeeded by a decline. In a second experiment, the initial rise and succeeding drop correspond with those of the first mentioned experiment, and a second rise occurs, but does not occur until just before the completion of four miles of rubbing, and it is not immediately succeeded by a decline. This experiment having been discontinued shortly after the completion of the second rise, what might have followed had the experiment been further extended is uncertain. In a third experiment, the initial rise is not followed by any very marked immediate decline, and, within the limits of the experiment, no subsequent rise of temperature, of the character occurring in the other two experiments, occurs. The explanation of these phenomena, given in the Club paper, is that the first rise of temperature of the shoe occurs while the tread of the wheel is cold, and that the temperature line subsequently drops because the heat becomes at a later time imparted to the wheel. Still later, the line of temperature of the shoe again rises because the wheel tread has become heated and has not the same capability of conducting away the heat of the shoe. The marked absence of uniformity in the results of the three experiments illustrated by diagrams—all of which were conducted under the same conditions, presents an obstacle to the satisfactory acceptance of this view. In addition, however, it cannot be doubted that heating of the wheel tread begins immediately with the application of the shoe and continues as rapidly as loss of heat through radiation and conduction into the atmosphere will permit. The supply of heat, though not uniform, is continuous, so that, while all parts of the *shoe* may not be simultaneously affected to the same extent, the heating of the *wheel* should be continuous and uninterrupted over the whole peripheral surface. Under these conditions, it is not at all apparent through the reasoning adopted, why the temperature of the shoe should at first greatly increase and then decline after the wheel has become at least somewhat heated at the surface and the conditions are therefore less propitious for conducting away the heat of the shoe than they were at first. This explanation does not therefore seem to satisfactorily account for a decline of the temperature of the shoe at the point at which the thermo-electric couple was situated.

As has already been pointed out, it is inconceivable that a very high temperature is not almost immediately reached at the actual rubbing surface of the shoe, so high that, if the writer's view is correct, the structure of the metal at the surface has already undergone a very marked change before the temperature line furnished by the recording apparatus has even begun to rise. A large amount of heat is continually being conducted away and, to a very considerable extent, dissipated, by the surface of the wheel and a considerable part of the remaining portion of the heat supplied is absorbed in the work of modifying the structure of the metal at and near the surface of the shoe. Only what still remains of the heat generated can be conducted into the interior of the shoe. Although the location of the thermo-electric couple was not far from the surface of the shoe, it is obvious, from the fact that in the neighborhood of fifteen or sixteen seconds elapsed after the beginning of the application before the couple was sensibly affected by the heat, that the amount of surplus heat so conducted into the interior of the shoe could not have been very great. As the amount of such surplus heat becomes reduced through the decline of the heat supply, when the coefficient of friction becomes reduced, it may be imagined that something in the nature of a wave of surplus heat, at first increasing to a maximum and then declining, travels into the interior of the shoe, and thus explains the first characteristic of the temperature line at the point where the thermo-electric couple was situated.

The cases in which a subsequent material rise and fall of temperature is shown in the diagrams, seem to have no marked features of regularity. As the temperature of the shoe was taken at only two points, one near each end of the shoe, it seems most probable that these disturbances were local and due to the effect of local conditions. Such effects may be attributable to hard spots or other irregularities in the structure of the material of the shoe and very likely accompanied by irregularities in the conformation of the shoe to the wheel. The effect of the presence of a hard spot would be to cause a redistribution of the pressure over the surface of the shoe, concentrating it at the spot that wears away with the greater difficulty. This would naturally result in a decline of the friction line and in excessive heating in the vicinity of the concentrated pressure. It will be observed, by reference to the diagrams under consideration, that repeated fluctuations occur in the friction line, indicating a succession of such disturbances. It is also a noteworthy fact that, in the two diagrams in which a late material rise of temperature occurs, it is in each case preceded by a decline of the friction line. This fact strengthens the plausibility of the explanation that, from some cause—probably the presence of such a hard spot or irregularity of texture, the pressure had in these particular instances been concentrated near that portion of the shoe in which the temperature recording device was located. In consequence, the friction declined and the locality became heated. As would be expected from the tardy response of the recording device at the beginning of each test, the time occupied in running a thousand feet or more must elapse after the hard spot begins to manifest its influence upon the friction line before the temperature recording device becomes sufficiently affected to cause the temperature line to shoot upward; and the diagrams show that such was the case. Whatever difficulty may be encountered in the acceptance of these explanations, they appear to the writer to be more satisfactory and accompanied by much less difficulty than the explanation advanced in the Railway Club paper.

Accidental Irregularities.

It seems desirable to digress here, as a convenient point for the consideration of the subject of irregularities in general. The occurrence of apparent irregularities in the friction line, during all classes of brake-shoe tests, is very common. Although they have been stated in the Railway Club paper to occur without apparent reason, it is clear that some sufficient reason must exist in each particular case, and it is believed that all such irregularities are principally attributable to the causes already suggested. Broadly speaking, all accidental irregularities in the friction line, not due to vibrations of the recording mechanism, may be regarded as resulting from variation of the pressure per square inch of the rubbing surface actually in contact at the time. This unequal distribution of pressure must, in turn, be due in each case to some degree of temporary deformation of the rubbing surface. It would primarily result from lack of homogeneity of the material and, secondarily, from the effect of concentration of heat at the locality in which the material offering the greatest resistance to removal is present. It would be accompanied by linear expansion in one or more sections of the rubbing surface while contraction would occur in other sections, where the heat supply is temporarily reduced. If such be the case, it may properly be expected that the frequency and extent of such accidental irregularities will vary considerably with the character of the material of which the shoe is composed. The material customarily employed in cast-iron brake shoes is not of as good quality or of as homogeneous a character as that employed for machine castings, for instance, and it should be expected that a more regular friction line would occur with the use of shoes of homogeneous soft cast-iron than with the use of shoes of the kind of iron customarily employed. In this connection, also, it is to be noted that the vibrations of the recording apparatus of the testing machine are sometimes very considerable, and the extent to which both accidental irregularities and also the more pronounced general characteristic fluctuations of the friction line may be magnified or distorted from this cause, is not easy to determine.

The second feature of the temperature tests reported in the Railway Club paper which may seem in conflict with the heat theory that has been advanced, is the statement that variation of the initial temperature of the shoe in stop tests produced no effect upon the mean coefficient of friction. In an examination of this statement, it is, in the first place, evident that, if the heat theory is sound, the only difference to be expected in the character of the friction lines of diagrams from stop tests made with different initial temperatures of the shoe, would be that a somewhat shorter time would elapse before a somewhat lower initial maximum value of the coefficient of friction is attained when the shoe is initially hot than when it is initially cold. This interval of time has been shown to be less than two seconds when the shoe is cold, so that, even if the initial temperature be quite high, and the initial maximum value of the coefficient of friction thereby be considerably reduced, the principal effect of the high initial temperature of the shoe would practically end there and the influence upon the mean coefficient of friction for the entire stop would be comparatively slight. Moreover, the hot shoe is not initially distorted to such an extent as it would be if allowed to cool, and the time required for its conformation to the surface of the wheel is reduced, so that the initial maximum value of the coefficient of friction occurs earlier, which tends to offset the fact of the lower initial maximum value upon the mean coefficient of friction. But the statement itself appears to be only approximately correct. Careful examination of the plotted values of the mean coefficient of friction in these stop tests, where the shoe had different initial temperatures, clearly shows that, while the line of plotted mean coefficients is somewhat irregular and does not indicate a wide variation of values, there is a distinct tendency of the mean coefficient of friction to decline as the initial temperature of the shoe is increased. For the reasons already stated, no very considerable decline of the value of the mean coefficient of friction should be expected to result from such a variation of the initial temperature of the shoe, and, in reality, therefore, the results of this series of tests not only do not conflict with the theory herein advanced, but, on the contrary, actually seem to support and justify it.

Experimental Conditions and Apparatus.

Briefly recapitulated, the influences causing regularly observed variation of the coefficient of friction, so far as now known, are variation of the pressure per square inch of rubbing surface, variation of the speed of rubbing, and continued rubbing itself. The effect of variation of the pressure per square inch is probably not independent of the area and outline form of the surface of the brake shoe, but is influenced both by the scale forming the boundary and the different character of the structure of the metal in the vicinity of the boundary of the surface. The effect of variation of either pressure or speed is necessarily accompanied, and consequently somewhat obscured, by the effect of continued rubbing. With the adoption of a definite and invariable method of applying the pressure of the brake shoe upon the wheel, corresponding with that in regular practical railroad service, so that the character of the friction line during the rise to its initial maximum shall be the same as in such service, the initial maximum

value of the coefficient of friction should be regarded as the representative value for the pressure and the speed under which it occurs. In order that the frictional resistance during the period of attaining the initial maximum value of the coefficient of friction may not be the means of introducing confusion and error, through causing an indeterminate, even though slight, reduction of the reference speed, the initial speed must be made the speed of reference and must be maintained continuously throughout the experiment, which must be continued through a period of time sufficiently great to determine the complete effect of continued rubbing.

The question of suitable conditions for conducting experiments is not free from perplexity. Values of the coefficient of friction of the Westinghouse-Galton experiments are, in general, less than the corresponding values found with the testing machine, under apparently similar conditions. In the Westinghouse-Galton experiments, the conditions were those of actual service. The constant rolling of the wheel upon the rail necessarily results in its presenting to the brake shoe a surface of a different character from that presented in experiments upon the testing machine. The effect upon the coefficient of friction may be such that data obtained from the testing machine does not fairly represent the conditions of practical service, where practical application of the information is alone useful. The suitability of the testing machine as a means of securing correct information may be questioned in at least one other respect. The pencil which traces the friction line is actuated through direct mechanical connection with the brake shoe, involving the influence of the inertia of connections to an extent that introduces very objectionable vibration. A recording mechanism that will enable the coefficient of friction to be accurately determined to the nearest tenth of one per cent. is sufficiently refined for practical purposes and is very greatly to be preferred to a mechanism of greater refinement of record but which introduces the complications arising from vibration. The initial maximum value of the coefficient of friction terminates a rapid rise of the friction line, which is probably immediately followed by a decline. That is, it is itself in the nature of a vibration and its accurate determination will be very seriously complicated by concurrent vibratory disturbance of the recording mechanism. The recording appartaus used in the Westinghouse-Galton experiments seems to have been admirably adapted to the purpose. The frictional force operating upon the brake shoe was delivered to a free piston, so operating upon a diaphragm in a closed receptacle that an extremely small range of movement only could in any case occur, and the pressure was therefrom transmitted through liquid to an indicator that finally produced the diagram. The effect of inertia of moving parts was thereby largely eliminated and the character of the apparatus seems to have been such as insured a high degree of accuracy without the sacrifice of refined precision.

Without doubt, the advantage of securing information under the actual conditions of practical service is a very potent reason for conducting experiments upon a moving car. The difficulties of preserving proper adjustment of the various kinds of necessary recording apparatus, especially at the higher speeds, of maintaining uniformity of speed, and of securing identity of condition of wheel and rail in different experiments, are, on the other hand, serious obstacles and suggest the advantages of a testing machine. If a testing machine is to be used, however, it seems obvious that it should be differently organized in several important respects from that heretofore employed. Suitable conditions seem to necessarily imply the use of an actual car wheel, rolling and exerting the proper pressure upon a supporting wheel, the periphery of which corresponds in form to a rail head, and this condition seems to entail the use of a pair of car wheels, so supported, in order to avoid lateral displacement and disturbance. A machine of such a construction should be so designed as to involve no serious complication in the way of unusual journal friction—that is, differing materially in degree or effect from that of customary car construction. The proper method of applying pressure to the shoes has already been suggested, as well as the important characteristics of the recording mechanism. When all these matters are taken into consideration, it may well be doubted if any other method of conducting brake-shoe experiments is equally satisfactory with that employing a moving vehicle, in much the same practical manner as that adopted in the Westinghouse-Galton experiments.

It would be difficult to conclude this review of the subject of brake-shoe friction without an expression of admiration for the brilliant conception, masterly conduct and able conclusions of the Westinghouse-Galton system of experiments. They were projected at a time when existing information and preconceived views were not only of no assistance in suggesting either the character of the apparatus required or the necessary scope of the experiments, but were so grossly incorrect and misleading that a long series of modifications of any original plans would seem to be inevitable before proper lines of investigation should finally be discovered. Yet, it is difficult even now to suggest an improvement upon the devices and provisions then adopted for the investigation. The information secured is the most reliable in existence to-day and the conclusions reached stand uncontradicted and almost unimproved. The only error was that of incompleteness. Had those experiments been extended to distinguish the effect of varied pressure, to determine the character of the initial rise of the friction line, and to follow the depreciating influence of continued rubbing upon the coefficient of friction to its ultimate conclusion, the subject would have been, so far as can now be judged, completely analyzed and ready for mathematical formulation to fulfil the practical requirements of to-day, except insofar as intervening advancement in the operating conditions upon railroads might require an extension of the range of conditions originally included within scope of the tests. The accurate judgment with which the conception of these experiments blazed the way through an untrodden field of investigation is only more clearly revealed in the light of the unfortunate conclusions derived from more recent investigation, conducted upon different lines.

The "Standard" Acetylene Car Lighting System.

The Standard Acetylene Lighting Co., of Springfield, Mass., will exhibit at the M. C. B. convention, at Saratoga, a private car which the company has fitted up with its apparatus for lighting with acetylene gas. This apparatus is designed especially for lighting passenger cars, but the same ideas are embodied in its generators for station lighting. Cars equipped with this system of lighting have been in regular service for five months on the Boston & Albany and have given good results.

In this system no storage tanks are used and the generator, one for each car, supplies the gas automatically as required. It is of that class of generators in which the carbide is fed to the water, the amount of gas made being controlled by the rate of feeding the carbide. This generator has passed the National Board of Underwriters, so that its use in stations does not affect the insurance on those buildings.

The generator used on cars requires a floor space of 18 in. wide x 28 in. long and the apparatus weighs about 350 lbs. in working order. In the car fitted up for exhibition purposes, a charge consists of 30 gals. of water and 30 lbs. of carbide, which will produce about 150 cu. ft. of gas or sufficient for 35 hours lighting with the 14 burners. A generator having between three and four times the capacity of this one can be put in the same space, if this greater capacity is required by the run.

The generator is shown by the accompanying engravings. Three cylindrical tanks, open at the bottom, are mounted on a conical base and all the joints are riveted and soldered. The middle tank, B, is the gas chamber and has a capacity of about 1 cu. ft. of gas, while the two side tanks, E, are water columns, with pipes leading from the upper ends to the atmosphere outside the car. The carbide is put into A through the top, the lid being screwed down tight on a gasket. The gas chamber and side columns are filled with water to the dotted line.

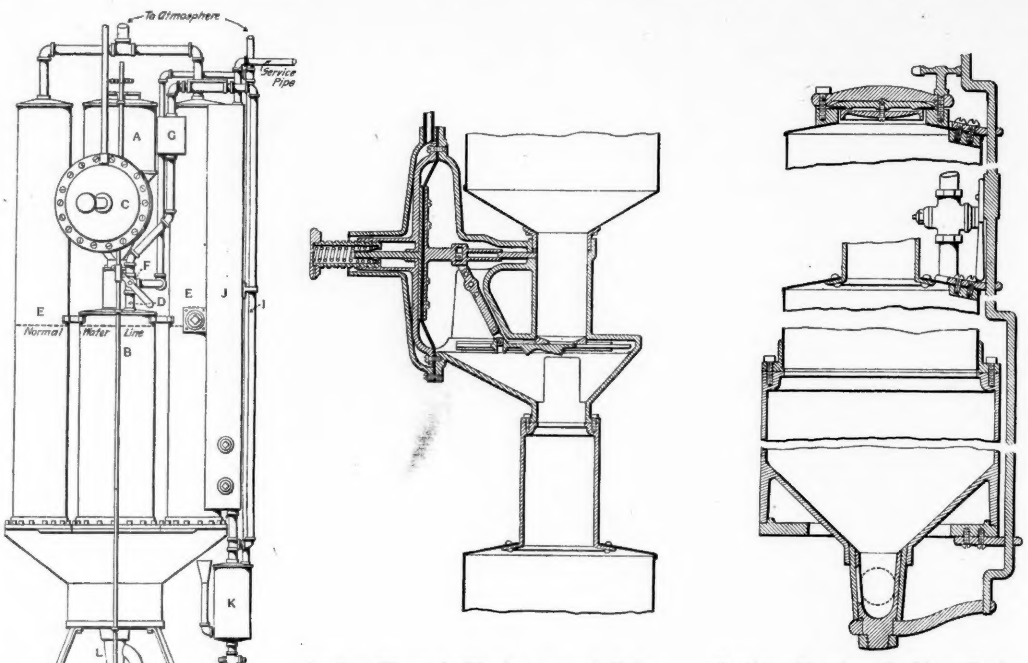
As the gas is generated in B, the water is lowered in the middle column and consequently is raised in the side columns, thus giving the desired pressure on the apparatus. As operated, the pressure in the gas chamber varies from 8 to 16 oz. and a pressure of 24 oz. drives the water out of chamber B and allows gas to enter at the bottom of the side columns and so escape to the atmosphere through these water columns and the pipes at the top.

The valve and diaphragm controlling the admission of carbide to the gas chamber is shown in section. This consists of a slide covering the opening between A and B, which slide is controlled by pressure on the diaphragm C. The slide is shown in the closed position. When the pressure in the gas chamber falls, the diaphragm is moved out under the action of the spring opening the slide and allowing a small amount of carbide to drop into the water below. This generates gas and raises the pressure, causing the diaphragm to move back and so close the slide.

From the top of chamber B the gas is drawn off through a pipe to the bottom of the scrubber J. It then passes up through J and is cleaned, and then goes out through a pipe at the top. Just after leaving the scrubber, the gas passes a reducing valve which is so set that a pressure of 2.3 oz. is maintained at the burners. The service pipe leads from the reducing valve. G is a small tank to condense any moisture there may be in the gas, and K is used to insure that any excess pressure will be relieved by gas escaping to the atmosphere and is not essential for the car apparatus.

The fastenings on the lid of chamber A and the discharge valve L at the bottom of the generator are interlocked with the three-way cock F. In this way before the generator can be recharged or cleaned, this three-way cock must be turned which opens a direct passage between the gas chamber and the atmosphere. In the same way these openings must be properly closed before the three-way cock can be turned, admitting gas to the service pipes.

As a result of dropping small amounts of carbide in a large volume of water the apparatus is always worked at a low temperature; 110 deg. F. is the maximum temperature ever attained in experiments with this generator, and in ordinary service the temperature is much below this point. As is well known generating at a low temperature improves the quality of the gas. Other advantages claimed for the system are its freedom from storage tanks and internal valves, the low pressure maintained and the small quantity of gas carried on the car at any given time.



Section Through Diaphragm and Valve. *Section Showing Locking Device.*

Standard Acetylene Lighting System.

The Huff Track Sander.

The illustrations shown are of the Huff track sander, which is being put on the market by the Huff Track Sanding Co., Boston, Mass. Fig. 1 shows the two-way sander; Fig. 2 the foot valve, which is an important part of the equipment; Fig. 3 the tube which runs through each compartment of the sander; Fig. 4 the three-way sander; and Fig. 5 the engineer's sander valve, a new device.

In applying this sander to a locomotive a Y is used in the sand pipe about 12 in. from the dome, or as much lower as is necessary, and two branch pipes 1¼ in. in diameter are run from it. Right and left threads are

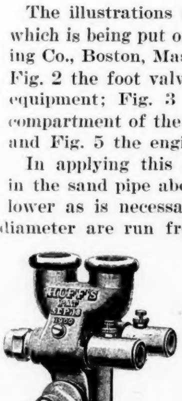


Fig. 1.

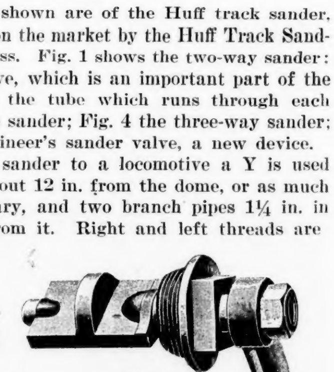


Fig. 2.

Fig. 3.

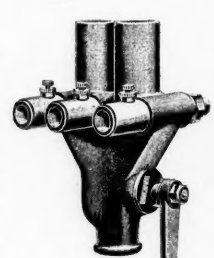


Fig. 4.

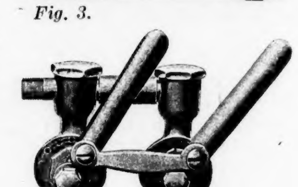


Fig. 5.

The Huff Sander.

used to avoid unions. When the height of the boiler will permit, the sanders are put below the running-board, and the handles of the foot valves are connected by a rod from the right to the left sander. With this arrangement a rod running to the cab from the foot valve makes it possible to drop out any obstruction that may find its way into the sand pipes. This is done by shutting off the sand from the dome and turning the foot valve, which allows all sand in the pipes of the sander to drop through the 1¼-in. pipe to the ground. The main sand valve in the dome can also be closed a few miles from the terminal, and thus prevent moisture from collecting in the sand supply in cold weather. When the closure is made on the main supply there is still enough sand in the pipes to run into the terminal under any ordinary conditions.

The sander can be used as a one-way sander if desirable. This is done by turning one of the tubes, Fig. 3, so that its opening, which is about 1 in. long and ¾ of an inch wide across its smaller axis, is shut off against the wall of the sander. These tubes control the amount of sand which is admitted, by their openings being turned toward or from the sand supply. The air connections are at one end of the tubes, and the other ends are connected with the sand pipes leading to the rails.

The three-way sander is practically the same as the two-way sander, except that there are three tubes, and two of them are in one compartment. The three-way sander can be used to deliver one, two or three ways and supply sand to every wheel of the heaviest engines, in any quantity desired.

The engineer's valve, Fig. 5, has been tested and proved satisfactory. It can be located in any desirable place in the cab, and as may be seen from the illustration, requires little room. When used with the two-way sander the forward valve controls the sand delivered to the front drivers, and the rear valve controls the supply for the rear drivers. When it is used on engines having more driving wheels the forward valve supplies air to work two tubes, giving sand for both forward drivers, and the rear valve works similarly for the back drivers.

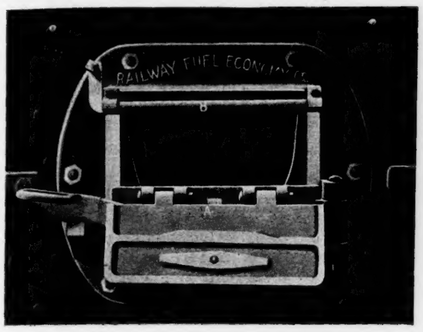


Fig. 1.

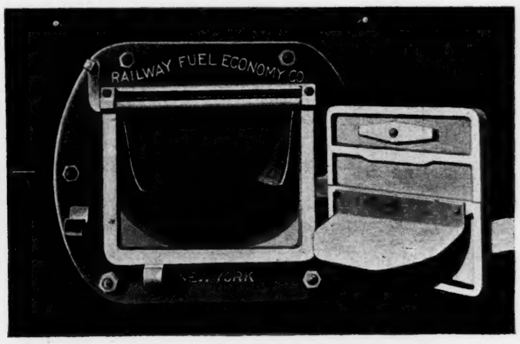


Fig. 2.

The Bates Fire Door.

The Bates Patent Fire Door.

On page 270 of the *Railroad Gazette*, April 27, 1900, we gave illustrations and a record of service of the Bates patent fire door, in an article on smokeless firing on the Southern Pacific System. The door was invented by Mr. F. L. Bates, Master Mechanic of the Southern Pacific, at San Francisco, and is being put on the market by the Railway Fuel Economy Company, 1 Broadway, New York.

To make clear the action of this door it should first be said that a shield or deflector is projected downwardly and into the fire-box from the upper portion of the door, and that there is also a similar but shorter deflector from about the mid-height of the door to prevent coal from lodging in the furnace doorway. It is clear that the purpose of these deflectors is to insure the delivery of the coal and also to direct the air currents in their passage into the fire-box. Fig. 1 shows the door with the upper half, A, opened and in the usual running position. The air deflector, B, is also well illustrated. The firing is done through the opening shown and a small scoop is used. This open position of the upper half of the door is maintained at all times, except when the fire is cleaned at the end of the run. Fig. 2 shows the entire door swung open as for the last named service, and also shows the lower deflector at the middle of the door, earlier referred to.

In firing with this door coal must be used in small quantities at comparatively short intervals, and it is necessary to use a brick arch. With these arrangements the introduction of oxygen, mingling with the gases, produces an increased efficiency due to the consumption of what is commonly the waste products—the gases, and strong testimonials from well-known Superintendents of Motive Power and also from engine crews who have used the door have been received. The saving in fuel and the betterment of steaming qualities of the boiler, as well as the almost total absence of black smoke, are well attested. The device has been used on Southern Pacific locomotives for several years, and more than 500 locomotives on that road now have it. It is also being used on many other roads.

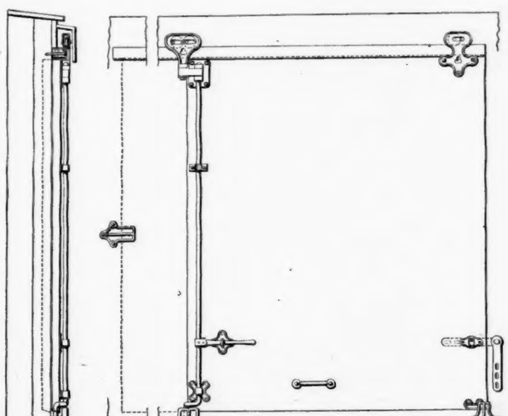
A striking instance of economy brought about by the use of this door has been called to our attention. On one road having a number of consolidation engines that did not steam up to their duty an estimate for remodeling the fire-boxes of all of them indicated that an outlay of several thousand dollars would be necessary. The Bates fire door was tried before the work of remodeling was undertaken, and it worked so well that there was no longer any difficulty in making steam, and the fire-boxes were therefore not remodeled. A point in favor of this device is its cheapness and simplicity. It can readily be fitted to any size or shape of fire door opening, and where a fire brick arch is already in use no alteration of the fire-box is necessary, but it is necessary that the brick arch be kept in close contact with the sides of the fire-box to obtain the best results. The reason for this is clear.

The Economy Flush Car Door.

This new rigging for flush car doors is put on the market by the Railway Fuel Economy Company, to which company we are indebted for the drawing showing details and for the following description:

The guide and supporting rail, 2½ x ⅜ in., is suspended on spruce blocks, 15-in. apart, and bolted through the side plate with countersunk bolts. This prevents accumulation of dirt and cinders and binding of the door. There is no lower rail. The door opening is free and trucks can back up against the side without injury to the door. The bracket on the front end of the door is cast in one piece and securely bolted with three ½ x 2-in. square-head bolts, in recessed squares, preventing the head from turning. The bracket on the rear end has two flanged wheels fitted with steel pins, and a toe 1-in. diameter by 3-in. long on the lower end, which engages an arm on the bracket. This arm is held in place by the operating rod.

The operating rod is 1-in. diameter, and is pinned to the arm. When moved by the locking lever 1-5 of the radius it turns the arm on the extension of the bracket and brings the door on a line with the rail. This clears the door opening. The locking lever when turned at right angles to the rod moves the door from its flush position to a point clear of the door opening. It is 18-in. from the door sill and within easy reach. When the door is closed it engages in a plate having a slotted neck through which the lock or seal may be placed. The lower end of the operating rod is bent in two directions, making an offsetted toe at 4-in. from the rod center. This toe engages with a cleat casting on the lower rear end of the door and performs the same duty as the arm on the bracket and rod. The cleat is made especially heavy to withstand injury from push bars and loading trucks.



The Economy Flush Car Door.

The lower front end of the door is provided with a casting securely bolted with two ⅛ x 2-in. square head bolts, and acts as a guide and wedge, keeping the door rigid when in either an opened or closed position. There is a heavy doorstop at full door distance from the door opening. Acting with the wedge above described it prevents the door from swinging if run in an open position. There is also a ventilating hasp, that may be used as a locking and sealing point.

A guide or cleat-casting is placed on the lower front end which engages with the wedge above described and prevents any pressure applied from the inside of the door from forcing it out. Two rabbetted strips are fastened to the door post or when desired a recess can be cut in the door post, which allows the door to close flush with the car body and also acts as a weather strip. The lower end of the door is given a bevel conforming to a similar one cut into the flooring.

The makers claim the following points of advantage for this door: The entire weight of the door is carried on the upper rail, and running on trolley wheels makes opening and closing very simple and easy. Doing away with the lower rail decreases the cost and leaves the doorway free and clear. The door, closing flush with the car body, makes it absolutely storm and cinder proof. The skeleton rail formation prevents the accumulation of dirt and cinders, and does away with the cost of a storm cover. The parts are few and the castings of heavy malleable iron make durability the most prominent feature. The bracket construction is such that the door cannot become detached and it thus prevents accidents and reduces the cost of renewals.

Operating the Siberian Railroad.

The winter's experience on the Siberian Railroad is said to have been very unfavorable, there being many derailments by reason of the breaking of the 50-lb. rails. It was intended before the end of last year to increase sidings, etc., so as to make possible the passage of 10 trains each way daily; but so far eight has been the greatest number that could be despatched, and on account of snow, etc., the number of cars in a train had to be reduced about 15 per cent. In Tomsk freight delivered to be forwarded to Irkutsk, Aug. 24, was not shipped until Dec. 31. Doubtless the necessity of providing for the exigencies of the Chinese troubles had much to do with this delay; but it shows at what great disadvantage Russia conducts military operations at such a great distance, with no intermediate considerable provision of either men or supplies.

One of the great disappointments was the failure of the great ice-breaking train-transfer boats on Lake Baikal. Damage to these vessels laid them up entirely for two months, and that when they were most needed. To keep up communication, a road was built across the lake on the ice, with bridges over the rifts, and an accompanying telegraph line.

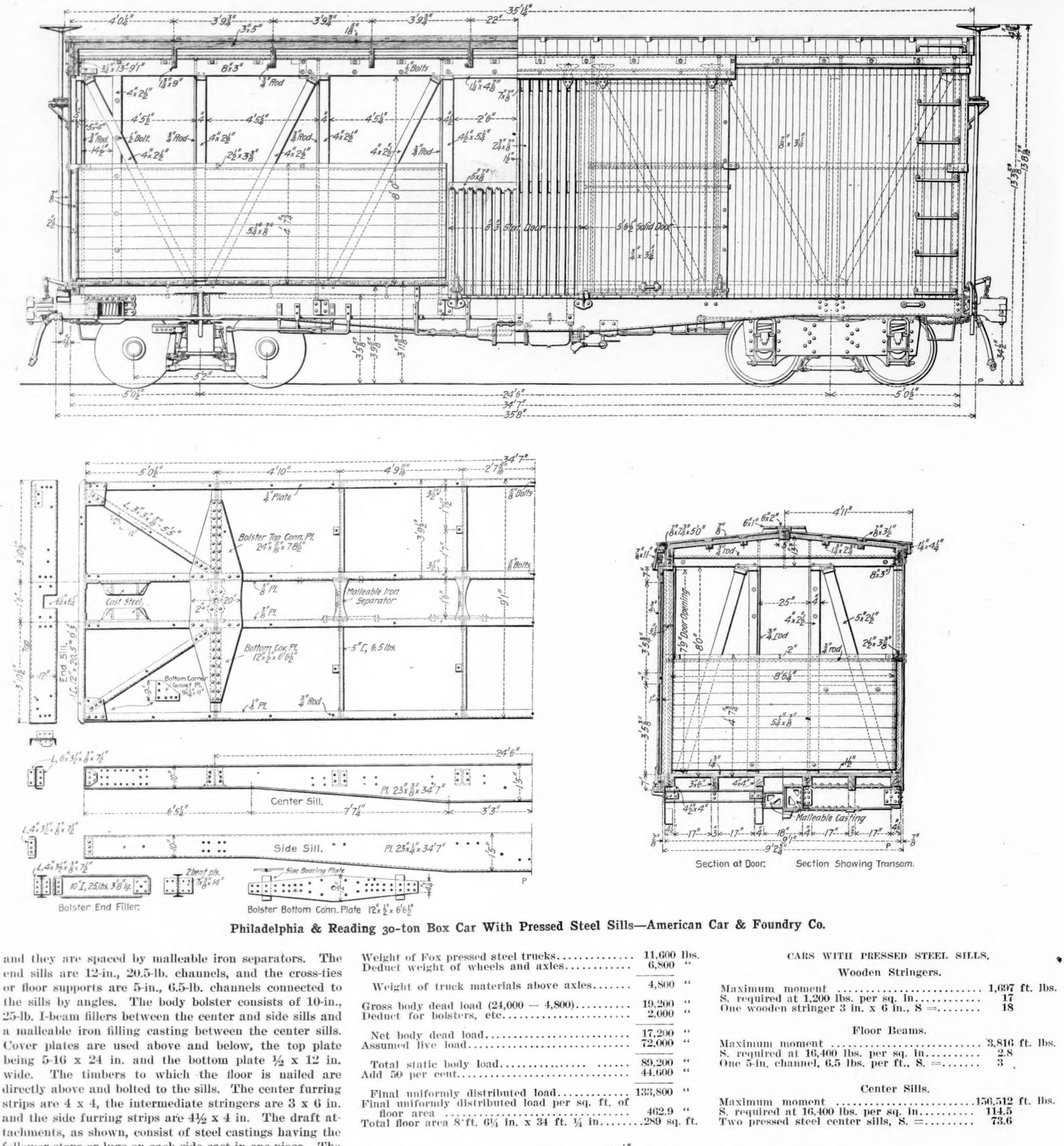
Philadelphia & Reading Box Cars with Steel Underframes.

There are now building by the American Car & Foundry Co. 500 box cars, of 60,000 lbs. capacity, for the Philadelphia & Reading. These cars have steel underframes, and are particularly interesting on account of the comparison that can be made between different designs of underframes. In all of the 500 cars the superstructure is wood, being built in accordance with the Philadelphia & Reading standard practice, and Fox pressed steel trucks are used for all. Of these, 480 have underframes of pressed steel longitudinal sills, and structural steel end sills, transoms and floor frames. Twenty cars have underframes designed in accordance with the ideas of Mr. George I. King, Manager of the Steel Car Department of the American Car & Foundry Co., who questions the strength of this pressed steel construction. These 20 cars have rolled steel longitudinal sills, cast steel end sills, and structural steel bolsters and floor frames. Mr. King's specifications, given in part in our issue of Jan. 4 last, have been followed in designing this lot of 20 cars, and it will be noticed that standard rolled shapes are used throughout. Of the cars with pressed steel sills, the underframe is of the same design as cars now in use on the Philadelphia & Reading.

At the time this order was placed the 45-ton sample box cars, illustrated in our issue of May 17, had not been built, and in these Philadelphia & Reading cars the superstructure was not designed to carry its share of the load as is now recommended by the American Car & Foundry Co. This latter design of upper framing results is less dead weight. The position which this company takes is that it will build any kind of cars wanted, but if the selection is left to the builders, Mr. King's specifications will be followed and, through preference, standard rolled shapes will be used.

The leading dimensions of these box cars are the same for all. The length inside is 34 ft. ¼ in., and the distance between the backs of end sills is 34 ft. 7 in. The width inside is 8 ft. 6¼ in., and, over all, the width is 10 ft. 1¾ in. The height over all is 13 ft. 8 7-16 in. From the rail to the eaves is 12 ft. 7 13-16 in. and the height inside under the eaves is 7 ft. 9 in. The load line for 66,000 lbs. of corn or rye is a little more than 5 ft. above the floor, and for wheat it is very nearly 4 ft. 9 in.

Cars with Pressed Steel Sills.—These have center sills of ⅜-in. steel plates forming a sill 17 in. deep at the center section and tapering to 10 in. at the body bolsters, beyond which the depth is uniform. These sills have the flanges turned outward, and are spaced 18 in. apart. The side sills are of the same form as the center sills, but the thickness of the plates is ¼ in. instead of ⅜ in. No cover plates are used for the center sills,



Philadelphia & Reading 30-ton Box Car With Pressed Steel Sills—American Car & Foundry Co.

and they are spaced by malleable iron separators. The end sills are 12-in., 20.5-lb. channels, and the cross-ties or floor supports are 5-in., 6.5-lb. channels connected to the sills by angles. The body bolster consists of 10-in., 25-lb. I-beam fillers between the center and side sills and a malleable iron filling casting between the center sills. Cover plates are used above and below, the top plate being 5-16 x 24 in. and the bottom plate ½ x 12 in. wide. The timbers to which the floor is nailed are directly above and bolted to the sills. The center furring strips are 4 x 4, the intermediate stringers are 3 x 6 in. and the side furring strips are 4½ x 4 in. The draft attachments, as shown, consist of steel castings having the follower stops or lugs on each side cast in one piece. The castings are strengthened by deep flanges, and are riveted direct to the sills. Twin springs are used in the draft gear.

Cars with Rolled Steel Sills.—The center sills are 12-in., 20.5-lb. steel channels spaced 18 in. apart with the flanges outward. Top and bottom cover plates, ⅜ in. thick, extend almost the whole distance between the body bolsters. The side sills are 8-in., 11.25-lb. channels to which lugs are riveted for supporting the posts of the upper framing and the side furring strips. The end sills are steel castings shown by the detail drawings and the floor and side supports are trusses built up of plates and channels as shown. The body bolsters are of the same general construction as in the other cars, excepting that 12-in., 31.5-lb. I-beam end fillers are used. The top cover plate is ¼ x 24 in. and the lower plate ½ x 12 in. wide.

The same design of cast steel draft attachments are used. The center furring strips are 4½ x 6 in., the intermediate 3 x 8 in., and the center furring strips are 2⅛ x 4 in.

The following data are from the calculations of stresses of these two cars, both cars being figured in accordance with the 1900 specifications of the American Car & Foundry Co.

ASSUMED LOADING FOR ALL.

A. C. & F. Co.'s specifications, 1900	4¼ in. x 8 in. journals
Base dead load	24,000 lbs.
Maximum live load	72,000 "

Weight of Fox pressed steel trucks	11,600 lbs.
Deduct weight of wheels and axles	6,800 "
Weight of truck materials above axles	4,800 "
Gross body dead load (24,000 — 4,800)	19,200 "
Deduct for bolsters, etc.	2,000 "
Net body dead load	17,200 "
Assumed live load	72,000 "
Total static body load	89,200 "
Add 50 per cent.	44,600 "
Final uniformly distributed load	133,800 "
Final uniformly distributed load per sq. ft. of floor area	462.9 "
Total floor area 8 ft. 6¼ in. x 34 ft. ¼ in.	289 sq. ft.

CARS WITH PRESSED STEEL SILLS.

Wooden Stringers.

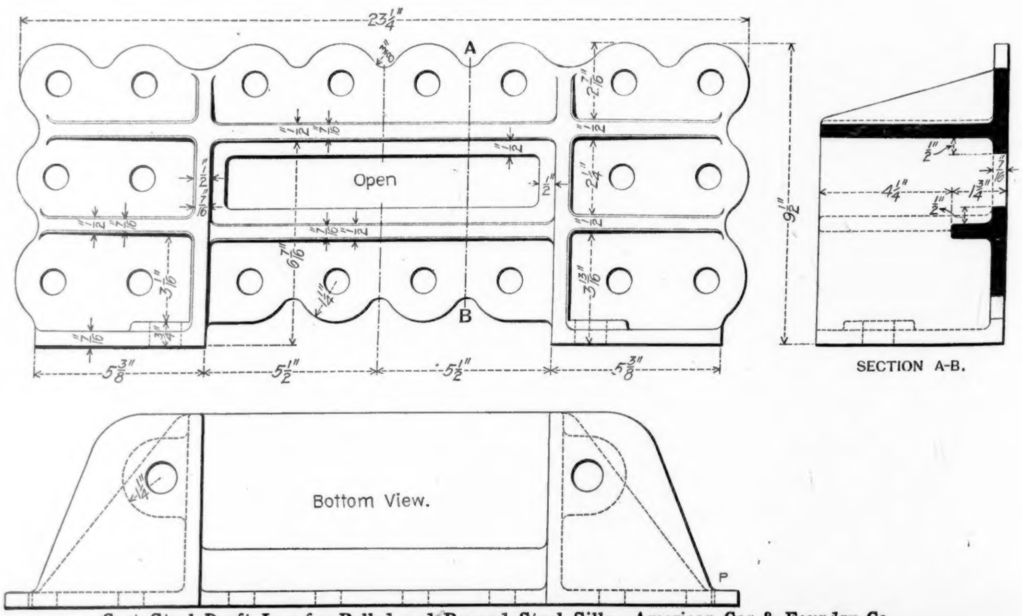
Maximum moment	1,697 ft. lbs.
S. required at 1,200 lbs. per sq. in.	17
One wooden stringer 3 in. x 6 in., S. =	18

Floor Beams.

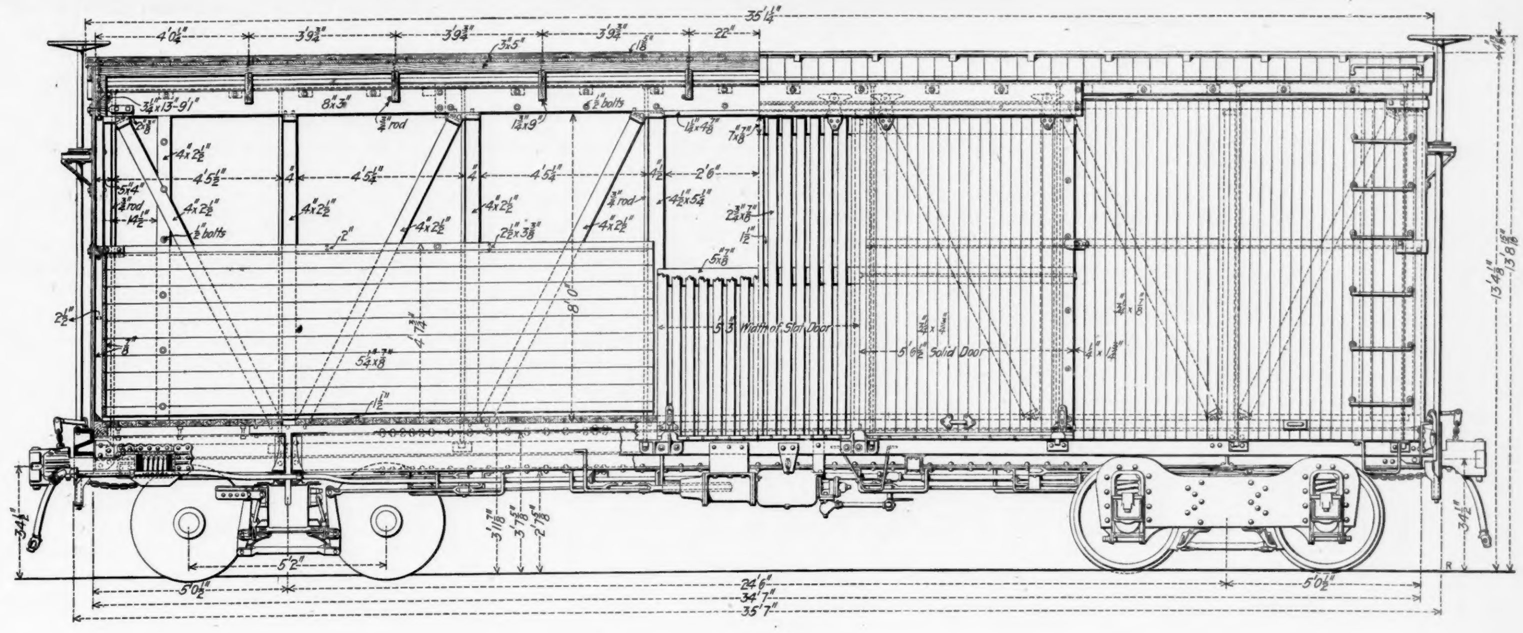
Maximum moment	3,816 ft. lbs.
S. required at 16,400 lbs. per sq. in.	2.8
One 5-in. channel, 6.5 lbs. per ft., S. =	3

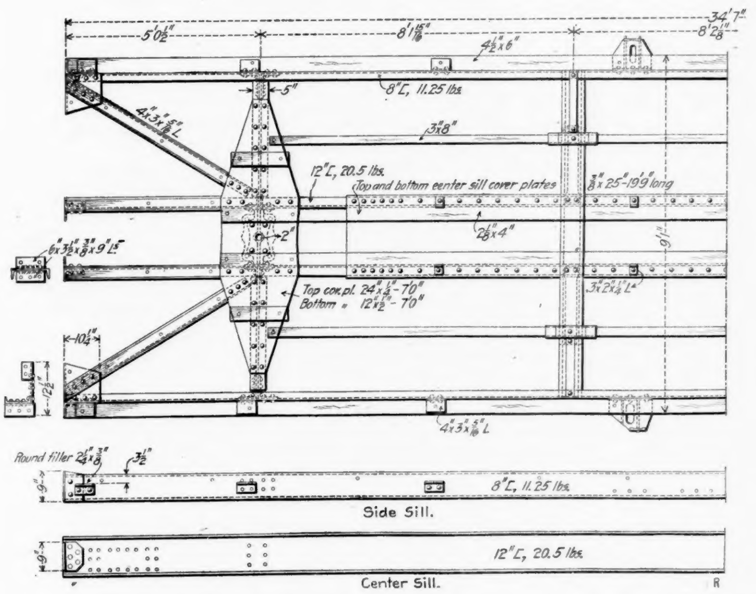
Center Sills.

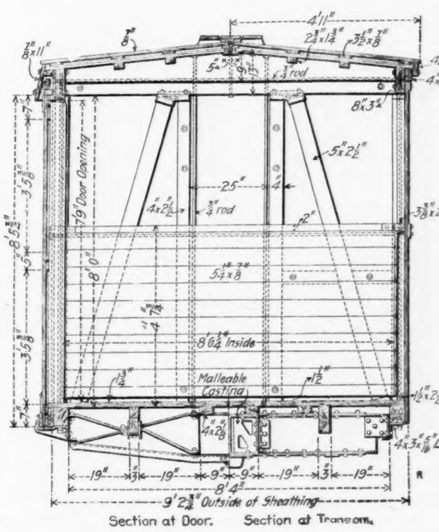
Maximum moment	156,512 ft. lbs.
S. required at 16,400 lbs. per sq. in.	114.5
Two pressed steel center sills, S. =	73.6

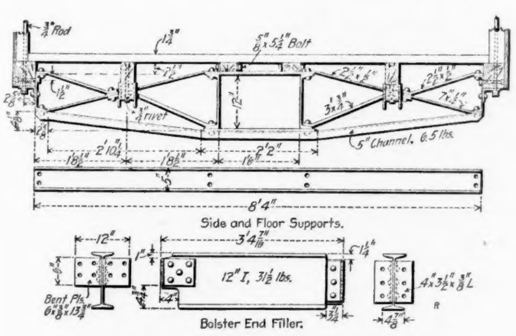


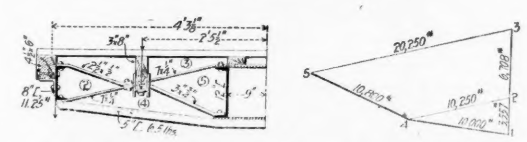
Cast Steel Draft Lug for Rolled and Pressed Steel Sills—American Car & Foundry Co.



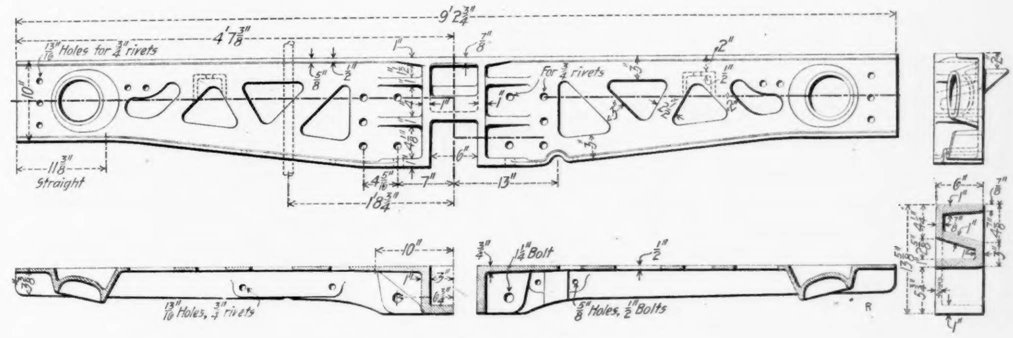








Stress Diagram, Side and Floor Support Brackets.



Cast Steel End Sill.

Philadelphia & Reading 30-ton Box Car With Rolled Steel Sills—American Car & Foundry Co.

Side Sills.

Maximum moment	23,618 ft. lbs.
S. required at 16,400 lbs. per sq. in.	33.8
One pressed steel side sill, S. =	22.5

Bolster.

Static load at end of bolster plus 100 per cent.	16,922 lbs.
Flange stress	77,032 "
Net area required for top cover plate at 15,000 lbs. per sq. in.	5.14 sq. in.
One top plate 24 x 5-16 in. net area	6.22 "
One bottom plate 12 in. x ½ in.	6 "
Number of rivets required in top plate (77,032 ÷ 5,300)	16-¾ in. diam.
Number of rivets required in bottom plate (77,032 ÷ 5,300)	16-¾ in. diam.
Cubic capacity to bottom of carlines	2,373 cu. ft.
Estimated weight of car	32,780 lbs.

CARS WITH ROLLED STEEL SILLS.

Wooden Stringers.

Maximum moment	3,497 ft. lbs.
S. required at 1,200 lbs. per sq. in.	35
One stringer 3 in. x 8 in. S. =	32

Center Sills.

Maximum moment	229,594 ft. lbs.
S. required at 16,400 lbs. per sq. in.	168
Two channels, 12 in., 20.5 lbs. } One top plate, 25 in. x ⅜ in. } One bottom plate, 25 in. x ⅜ in. }	S = 153

Side Sills.

Maximum moment	3,646 ft. lbs.
S. required at 16,400 lbs. per sq. in.	2.67
One channel, 8 in., 11.25 lbs., S. =	8.00

Side and Floor Support Brackets (See Stress Diagram.)

3—5 and 2—4:	
Maximum tension	20,250 lbs.
Area required at 16,400 lbs. per sq. in.	1.24 sq. in.
One plate, 7 x ¼ in. net area =	1.59 sq. in.
1—4:	
Maximum compression	10,000 lbs.
Area required at 8,760 lbs. per sq. in.	1.14 sq. in.
One channel, 5 in., 6.5 lbs., area	1.95 sq. in.
4—5:	
Maximum compression	10,800 lbs.
Area required at 7,770 lbs. per sq. in.	1.4 sq. in.
One bar 3 in. x ¾ in., area	2.25 sq. in.

Bolster.

Maximum moment from static loads, plus 100 per cent.	24,833 ft. lbs.
Flange stress	24,833 lbs.
Net area required for top cover plate at 15,000 lbs. per sq. in.	1.65 sq. in.
One top plate, 24 in. x ¼ in. net area	5.18 sq. in.
One bottom plate, 12 in. x ½ in.	6.00 sq. in.
Number of rivets required in top plate (24,833 ÷ 4,690)	6
Number of rivets required in bottom plate (24,833 ÷ 5,300)	5
Cubic capacity to bottom of carlines	2,373 cu. ft.
Estimated weight of car	33,780 lbs.

Foreign Railroad Notes.

A genuine curiosity illustrative of early German locomotive practice has been found among the effects left by a man who had been a locomotive engineer on the first German railroad, the Nuremberg & Fürth, which was opened Dec. 7, 1835. This is a working model of a locomotive used on that road in its early years, executed with great care. It has been acquired for the Imperial Post-office Museum in Berlin. There are extant drawings of the early German locomotives, but so far as known this is the only model.

The Prussian Minister of Public Works calls the attention of his subordinates to the fact that in the 13 months ending with August, 1900, no less than 59 railroad employees—chiefly enginemen and firemen—were killed or injured by coming in contact with permanent structures as they leaned out of trains, though in only three of these cases was the clear space prescribed by law impinged upon by the structure. He gives warning that whenever possible signal masts, etc., be placed so that even careless leaning out will not cause an accident.

RAILROAD GAZETTE

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EDITORIAL ANNOUNCEMENTS.

CONTRIBUTIONS—Subscribers and others will materially assist us in making our news accurate and complete if they will send us early information of events which take place under their observation, such as changes in railroad officers, organizations and changes of companies in their management, particulars as to the business of the letting, progress and completion of contracts for new works or important improvements of old ones, experiments in the construction of roads and machinery and railroads, and suggestions as to its improvement. Discussion of subjects pertaining to ALL DEPARTMENTS *of railroad business by men practically acquainted with them are especially desired. Officers will oblige us by forwarding early copies of notices of meetings, elections, appointments, and especially annual reports, some notice of all of which will be published.*

ADVERTISEMENTS—We wish it distinctly understood that we will entertain no proposition to publish anything in this journal for pay, EXCEPT IN THE ADVERTISING COLUMNS. *We give in our editorial columns* OUR OWN *opinions, and these only, and in our news columns present only such matter as we consider interesting and important to our readers. Those who wish to recommend their inventions, machinery, supplies, financial schemes, etc., to our readers, can do so fully in our advertising columns, but it is useless to ask us to recommend them editorially either for money or in consideration of advertising patronage.*

Mr. C. H. Quereau suggests that the M. C. B. Convention ought to discuss the question of doing something at once which will insure the proper maintenance of air-brakes, and especially the cleaning of triple valves, brake cylinders and retaining valves. Triple valves and brake cylinders get but scant attention, and the Rocky Mountain roads complain that Eastern roads as a rule pay no attention at all to retaining valves. Mr. Quereau finds that about 90 per cent. of the cars offered to his road at Denver in interchange have retaining valves that will not work and the failure of eastern lines to clean brake cylinders and triple valves is a continual source of trouble and delay. To bring about an improvement Mr. Quereau suggests that the Association establish such prices for cleaning and repairing brake cylinders, triple valves and retainers, that there will be a small profit for the road making the repairs. The idea is that in this way more roads will be induced to provide proper facilities for doing this repair work, and that there will be an incentive to keeping the brakes in order. It is objectionable, of course, to deviate from the principle that the prices for repair work shall be such that there will be no profit in repairing cars; but the air-brakes of freight cars are now in such a condition that radical measures are needed. Mr. Quereau will probably present his plan before the Convention during the discussion of the prices to be prescribed under the interchange rules.

Railroad gross earnings continue to move upward, as shown by the returns of the *Chronicle* for May. The gross earnings on 105 roads in that month this year were $60,358,000, which is an increase of $5,189,000 over the corresponding month a year ago. This increase follows heavy increases in preceding years, amounting to $5,402,000 in 1900; $3,059,000 in 1899, and $5,744,000 in 1898. The Illinois Central heads the list in increases for May with $500,600; then follow the Missouri Pacific with $413,400; the Missouri, Kansas & Texas, $400,300; the New York Central, $315,300; the Louisville & Nashville, $257,300; the Baltimore & Ohio, $253,600; the Northern Pacific, $231,500, and the Texas & Pacific, $207,900. There are only five roads that reported decreases of more than $30,000, the largest being the Buffalo, Rochester & Pittsburgh with $64,700. This improvement was in the face of considerable contraction in grain movement. The receipts of wheat in the western primary markets for the five weeks ended June 1, were only 12¼ million bushels against 13½ million bushels the corresponding weeks in 1900, and 13¾ million bushels in 1899. At Duluth the falling off was particularly heavy, being only 551,000 bushels in May this year, against 3,189,000 bushels in 1900. Movements of cotton were larger than for the preceding year. The shipments overland were 58,087 bales against 50,285 bales in 1900; while the receipts at the southern outports were 274,014 bales against 129,809 bales.

Electric Shop Equipment.

Attention is called to the article in this issue on the electrical equipment of railroad shops, by Mr. George A. Damon. Further development of the same subject will appear next week and the reader may profitably examine Mr. Dean's article on a closely allied matter which we printed last week. This subject is just now of great interest to railroads, so many are planning new shops or are considering extensive shop improvements involving the use of electricity. It is clear that no hard and fast rules can be laid down for modern railroad shop design and a fine field is here presented for the exercise of the judgment of the experienced engineer.

There seem to be good reasons why so much work of this kind is just now coming up. During the lean years following 1893, little money was available for shops, and since then the roads have first supplied their more immediate needs by large purchases of locomotives, cars, bridges and track material. The new engines are much heavier than those they replaced and cannot be maintained with best economy in the old shops. The tools are too small and the old methods of handling materials are not suited to the heavier work required on these big engines. Then, in many cases, railroad shops were originally designed by the engineering department with little reference to their operation; it was almost enough to make the buildings fit the ground space and present an agreeable architectural appearance. These shops, needless to say, have never been satisfactory and must be rebuilt. Further, railroads have been slow in replacing old machinery with improved machine tools and adopting modern methods of handling materials, the result being that railroad shop equipment as a whole is antiquated and out of date. All these things make it necessary to improve the facilities for maintaining the heavy motive power. The contrast between modern manufacturing plants and railroad shops is so marked that it is only surprising that the movement to rebuild the railroad shops has been so slow in starting. It is believed, however, that all this is fully realized by managing officers and that a great change will be effected in the next few years.

In rebuilding the important railroad shops of the country, which is the problem, the work will fall heavily on the men responsible for shop operation. Judging from new shops recently built, the work will be planned solely with a view to the reduction of shop costs. Very few railroad men have had experience in modern shops and lack the detail knowledge of modern shop equipment and methods which is essential to carrying out a general scheme. Very properly, the roads are availing themselves of the services of engineers who have been identified with the design and construction of manufacturing and power plants and this seems the logical thing to do. There can be no doubt that in this way many mistakes will be avoided.

The more important problems which arise in connection with the electrical equipment of a new shop are outlined by Mr. Damon and in a succeeding issue some power house questions will be discussed in a similar way.

The Study of Timber Decay and Preservation.

The burden of the investigation of the causes of decay in timber and of the means of prevention must finally fall on those who work for the love of science or for other motives than making money. In this it is not unlike all other work of research. The commercial results may be of great value, but they are generally so remote or indefinite that the work cannot be taken up for profit. Many of our readers will have noticed something of the excellent work that is being done under the United States Department of Agriculture at the Shaw School of Botany, St. Louis, in the investigation of the morbid pathology of timber. Dr. von Schrenk has told something of this work before the American Railway Engineering and Maintenance of Way Association at the last meeting in Chicago, and before various railroad clubs. Certain special work is now being organized which promises to be of great value.

One of the difficulties in the way of ascertaining the comparative value of different methods of preservation lies in the fact that these methods have not been tried side by side, with the same timber, subject to exactly the same conditions. To make conclusive comparisons each variety of timber should be treated by all of the preservative processes to be studied and then the samples should be exposed under identical conditions. Furthermore, in order that results can be got as speedily as possible the exposure should be under such conditions of climate and soil as tend to rapid decay.

It is proposed now to have sample ties treated, using say 20 or 30 ties for each process and each kind of timber and to lay these ties in track somewhere in the Gulf States where heat and moisture induce quick destruction. The United States Government has made no appropriation for this sort of work, but the various companies in the business of preserving timber will do gratuitously all that is necessary in the way of treatment. Some of the railroads have undertaken to collect and transport the necessary number of ties.

Beyond this it is important to get data by actual examination of decayed ties that are now in the roadbed all over the United States. These data will have to be collected by a biologist who knows what to look for. The records of ties removed from track are of no value as showing why they were removed. The data collected in this way will have to be supplemented by experimental cultures conducted with strict scientific accuracy.

Still further, it is important to get the experience of European roads where tie treatment has been carried on for a longer time and on a very much greater scale than in this country. The engineers who have reported to us on this subject have not taken it up from the physiological and pathological point of view, and here is an immense amount of material ready for use. It is proposed to send some one to the continent of Europe this summer to collect information on the ground.

The Government has made no provision for the cost of these special studies, namely, the study of ties in track in the United States and the study of conditions in Europe. Several railroads have, however, indicated their readiness to contribute a small sum towards this work, giving whatever may be necessary, not to exceed say $500 in the case of any one railroad. No doubt there are many other railroad companies that will be glad to take part in this series of studies. Of course they could not possibly get the work done as cheaply in any other way, for the gentlemen who will do the bulk of it are employees of the United States Government, and it is an opportunity for the railroads to co-operate voluntarily with the Government in carrying on some very important investigations. Railroad officers who are interested in this matter may get any further information that they require from Dr. Hermann von Schrenk, Shaw School of Botany, St. Louis, Mo.

The Reports of the Master Mechanics' Association.

Extracts from the Master Mechanics' reports appear elsewhere, and below is a convenient summary for the information of those who are too busy to read the reports now.

Steps have been taken this year to change the Constitution and By-laws so that it will be plainly understood that either active or associate members are eligible to honorary membership. Further, nominations for honorary membership must be made by the Executive Committee, and this rule when put in effect will doubtless save a good deal of time in the meetings and avoid embarrassing discussions.

The committee on cast-iron and steel-tired wheels has nothing to report further than what was presented last year, and asks to be discharged. The committee on methods of doing locomotive tube work finds a great uniformity in practice, and the report is practically a description of the practice of the average shop. It was unable to get any definite information as to the merits of steel tubes as compared with charcoal iron tubes. A committee recommends that it is not advisable for the Master Mechanics' Association to join the International Association for Testing Materials until a more definite organization is effected. The suggestion is made that a better way is to adopt specifications which may be agreed on by the International Council, if endorsed by a majority of the members. The Master Mechanics' Association will then be free to depart from these specifications at any time a majority vote favors doing so. A committee reports that it was not expedient to establish a joint library with the Master Car Builders' Association. These are all short reports.

The committee on the cost of running trains at high speed is able to draw but one definite conclusion, namely, that it is fair to assume that the fuel used by locomotives increases directly as the speed increases. This was shown by special tests on the Chicago, Burlington & Quincy. The increased cost of other items due to speed has not been definitely determined.

In the matter of promising ways in which to save fuel, the committee first mentions compounding and urges the Association to take some definite stand, for or against the compound. The use of exhaust steam from the air pump and cylinders for heating the feed water comes next, and a plan is suggested for heating the water in the tank to about 200 deg. F., a pump being used to feed the boiler. The committee is not very enthusiastic about wide locomotive grates, but classes this as one way to effect economies under certain conditions. Some other ways discussed are reduced cylinder clearance, uniform grades of coal, long boiler tubes, superheating, and automatic stokers.

The report on roundhouses is a detailed description of the essentials of construction and equipment of a modern roundhouse and is a useful report, especially for those who may be called on to plan new work. It is recommended that the house be at least 80 ft. long and the turntable 70 ft. in diameter, preferably operated by electric motors; but if electricity is not available the gasoline engine can be used successfully. The boilers, pumps and machine tools should be in an annex. Electricity should be used for artificial light and preferably a hot air system of heating and ventilation should be installed. The house should be piped for compressed air.

A long report is presented on locomotive mileage which includes some interesting statistics from about 30 roads. The various topics are treated separately and a number of conclusions are drawn. Three of these only will be mentioned here: "That short divisions be lengthened so that the average service will consume from eight to ten hours over the division one way;" "that engines be double-crewed with extra men for relief when there is enough work on one engine for two men. When this is not the case, that they be single-crewed with extra men for relief; that with the change to the pooling system, adequate preparation be made for more careful inspection, and heavier charges to maintenance."

The committee on coaling stations presents plans of typical stations. It is said, in the cost of handling locomotive coal, much depends on the kind of cars in which the coal is loaded. If the coal is received in hopper bottom or side dump cars the cost is from one to three cents a ton delivered on the tender, no matter whether cars are pushed up an incline and dumped into pockets, or whether the place of the switch engine is taken by a system of power driven conveyors. If the coal is received in box cars the cost is from six to eight cents on the tender regardless of the kind of coaling station through which it passes. The advantages of the power plant are said to be in more independence at the coaling stations, not being required to wait on switching crews; the better housing of the fuel and the large storage which can be cheaply and quickly handled.

Beside the regular reports of committees, Mr. R. P. C. Sanderson presents an individual paper on standard locomotive classification. His plan, which has been put into effect on the Santa Fe, is to indicate the types of locomotives by the initial letter of the recognized names of the different types. Following this is a number representing the first two figures of the hauling capacity of the locomotive in tons, at ten miles an hour and on straight and level track. A small letter is affixed to follow the tonnage rating representing different makes of engines of the same type and tonnage class.

An individual paper is also presented by Mr. G. R. Henderson on practical tonnage rating. This includes formulas and diagrams from which the approximate rating of locomotives can be quickly determined from the office records. This is a paper which every one interested in the subject should study. We reprint it practically in full.

Oil-Car Collisions.

One of the most dangerous things that can be done by a man controlling a railroad train is to move back, or allow to be moved back, any part of the train, over the road which has just been traversed. One reason why this is particularly dangerous is that it is impossible to frame a rule covering the circumstances, for in many situations the danger is remote. Probably the most costly class of collisions that have occurred in the history of any railroad, in proportion to the number, are those in which oil is set afire or explosives are set off; and the most horrible train-accident that any one pictures to his imagination is the burning of a passenger train in a tunnel. We have to report this week a collision, happily free from serious casualty, in which all these untoward elements figured.

The reader will recall that a few weeks ago we noticed a smash-up of oil cars which resulted in a fire that destroyed about $50,000 worth of buildings. A train broke in two on a descending grade, and the rear portion then ran into the forward one. If all the cars of the train had been air-braked such a collision would not have occurred, or, at least, a collision would have been extremely unlikely to occur; whereas, with only hand brakes and two or three brakemen to depend upon, or with a part of the cars air-braked, but not all, a collision of this kind often follows a break-in-two in spite of all practicable vigilance. We now have to record a collision followed by an oil-fire, which embodied still more varied and serious possibilities of disaster; though only one person was injured and the property loss was not very great.

This collision occurred at Pittsburgh on the night of June 3 about 11 o'clock. It was on the line of the Pittsburgh, Cincinnati, Chicago & St. Louis between the point where that line crosses the Monongahela River and the Union Station. A freight train consisting of a number of platform cars loaded with steel billets and a single tank car full of oil, at the rear end, moving eastward (toward the Union Station), appears to have broken in two, just ahead of the tank car, about the time that it emerged from the 1,500-ft. tunnel between Fourth avenue and Washington street; and the tank car immediately began to move backward. A local passenger train, consisting of engine, baggage car and two passenger cars, was closely following, and it ran into and punctured the oil tank. The collision does not appear to have been severe enough to derail the engine or any of the cars, but the oil escaping from the tank took fire, and the passengers and trainmen, who immediately ran back toward the end of the tunnel at which they had just entered, were overtaken by smoke before they had gone far. One passenger on the rear car of the passenger train, an employee of the road, was injured, though not so seriously but that he (as well as all the others) succeeded in getting out of the tunnel. The freight trainmen soon went back after the car which they had lost, and pulled it out to a point 100 ft. from the mouth of the tunnel, where it was abandoned to burn. Until the car had been brought out, and had been burning some time, the flow of oil from it appears to have been small, but after a short time the oil inside became heated, and the tank exploded, spreading fire in all directions. The city fire companies saved the adjoining buildings from destruction. The combustible parts of the passenger train were destroyed.

The track at this point is equipped with rail-circuit automatic block signals; but as the engineman of the passenger train asserts that the block signal at the west end of the tunnel indicated to him all-clear, it is believed that the oil car broke away from its train just after it had passed out of the block section which includes the tunnel, but (the grade being descending westward) ran back into the block section which it had just vacated. The freight appears to have been a yard train, without a caboose. Why the rear brakeman did not keep the oil car from running back, or why he did not signal the passenger train, by lantern or torpedo, are points which the account does not clear up.

A collision of a passenger train with an oil train in a tunnel has long been the bête noire of those railroad managers whose experience calls this possibility frequently to their minds. Even with perfect block signaling this element of danger is a constant factor in every double-track tunnel, for the derailment of an oil car may throw the inflammable substance directly in the path of a passenger train on the adjacent track. That such accidents are exceedingly rare affords striking testimony to the skill and faithfulness not only of the trainmen and signalmen, but as well of the car inspectors, wheel makers and the dozens of other men whose work goes to make up the safety of a fast train, and whose duties are always performed under difficulties.

To the Superintendent who has to investigate the Pittsburgh collision the main question no doubt will be one of discipline, the immediate point being, Why was not the freight well handled and well protected at the rear? But the question of air-braking the whole train, which we alluded to at the outset, is of almost equal importance; perhaps, considering the comparatively new questions involved, it is more important; for a rule requiring all trains (or all trains carrying inflammable or explosive goods) to be air-braked throughout, can be carried out with a good degree of uniformity and efficiency, whereas a rule requiring rear brakemen to be vigilant in preventing detached cars from running back down grade is a difficult one to enforce. As for the rest of us, we may observe that the fact that the passenger train had only six or eight passengers aboard may be called a bit of good luck; likewise the circumstance that it had not got to going fast after leaving Fourth avenue station. That a tunnel is in or near a yard does not modify the fact that it is a horrible place for a collision or a fire; and that a train is going only on a short trip does not remove the necessity for vigilant trainmen, and for cabooses and air-brakes.

A well-known writer has said that danger lurks in every foot of a railroad. That is not a new truth; but some of the new conditions of the present day perhaps justify its re-statement. The condition that a brakeman may neglect to stop the rear cars of a train when they break away while going up grade is not a new one, but a very old one; but the combination of this with automatic block signals is comparatively new. With good block signals a brakeman may neglect his flagging a million times, and produce no bad results, as long as his train does not move backward, but a very short backward movement very quickly destroys the virtue of any and all safeguards. This has been illustrated in a number of instances of late, notably in the collisions at Offenbach, Germany, and Exeter, Pa., which the reader will recall. At Offenbach the road was worked under space interval rules; at Exeter, under the time interval. This particular danger needs to be guarded against with either plan. The destruction of a whole passenger train by fire in a tunnel is a very unpleasant "incident."

On another page appears an article giving a series of experiments with different forms and materials for staybolts on the Northern Railroad of France. The work is of some interest to Americans because in the engines latterly referred to the working steam pressures were fully as high as, in fact somewhat higher, than the highest pressure used on modern locomotives in the United States. The diagrams showing the proportion of staybolts broken in various parts of the boiler are entirely clear when considered with the matter that accompanies them. That progress has been made in the adoption of the metal which is called manganese bronze is apparent, although from the analysis it is found that manganese figures very little in the composition. It is stated that since 1896 3,500 copper-manganese staybolts have been used in the most trying parts of the fire-box and that up to Dec. 10, 1900, not a bolt had been broken; whereas in the first three months of 1897 copper staybolts broke at the rate of 543 a month in 40 locomotives that were being observed. This rate of breakage rapidly fell as the new kind of staybolts was substituted until, for the first three months of 1900, the record showed only 99 bolts broken in the 40 locomotives. In the course of the article it is stated that when soft steel staybolts were used in the copper fire-box sheets it was found that the thread openings in the sheets rapidly became oblong and seemed to suffer more than when either copper or bronze staybolts were used. Along the same line of reasoning it might be suggested that these bronze staybolts, if placed in steel fire-box sheets, might be distorted, in a sense, as the copper sheets were when fitted with steel staybolts; and therefore that they might not be as available to American builders as to those who use copper fire-boxes. To give a comparative value to the tensile strength given for the manganese bronze bolts, a record of some experiments with copper at various temperatures is here reproduced in part from Kent's Mechanical Engineer's Pocket-book. The experiments were made by the British Admiralty at Portsmouth dock-yard in 1877. At atmospheric temperature (not given) tensile strength in pounds per square inch was 23,115; at 100 degrees F. it increased to 23,366; at 200 degrees a decrease to 22,110 lbs. was shown; at 300 degrees the strength fell to 21,607; at 400 degrees to 21,105, and at 500 degrees to 19,597. Up to a temperature of 400 degrees F. the loss of strength was estimated at about 10 per cent., and at 500 degrees F. 16 per cent., indicating that above a temperature of 500 degrees the strength is seriously affected.

The Pennsylvania Railroad, which is at the front in the scheme of pensioning employees, held its annual meeting this week. It was announced that the net income of the road was $9,717,606. . . . Workingmen should demand their full independence, the right to provide by thrift for their non-earning days, and should compel the payment of all that should come to them in cash. This would keep things on the right bottoms.—*North Adams (Mass.) Transcript.*

Whatever the rights of "workingmen" a large proportion of them do not provide by thrift for their non-earning days even when they have no pension to look forward to. Probably they receive no less wages under a pension system than when the employer is not laying up money with which to pension employees. The Pennsylvania, for instance (and the other roads which pay pensions), pay wages as high as those of roads which do not give their men anything over and above their wages. Probably it is safe to say that the pensioning roads pay even higher than the average rate on all roads. The theory that they ought to pay still higher—ought to give in wages to men at work all the money that now goes to superannuated employees—would be quite attractive—as a theory—if anybody could be found who could tell how to put it in practice. When the pay received by workingmen from their employer is as high as that paid by other employers in the same region for similar services, the workingman's independence is about as nearly on the "right bottoms" as he is likely ever to be able to put it by any agitation about pensions. If, in addition, he has the consciousness that his employer is in the highest class of employers, as rated by financial standing, solidity of business prosperity and fair-mindedness in its officers, he will do well to give very little thought to his fears about his independence being on a false foundation.

The Boston & Maine has just given 800 new suits of clothes to its passenger conductors, baggagemen and brakemen. This custom of furnishing uniforms free was begun about a year ago; and we learn from an officer of the road that the management is well pleased with the idea. One result of the innovation was to make the new suits real "uniforms"—to produce a thorough uniformity in "fit, fabric and finish," and in color. This result would be possible, of course, while still requiring the men themselves to pay for their clothes, for we have seen a great improvement lately on another New England railroad; but if the company was ready to make this additional appropriation of fifteen or twenty thousand dollars it could not easily have found a more profitable way of spending the money. The most marked effect on the appearance of the men must be, however, at the end of the season, rather than at the beginning.

Car Lighting by Acetylene Gas.

BY H. E. SMITH.*

As is well known acetylene gas is made by the action of water upon calcium carbide. Very pure materials are required for the production of a good quality of carbide, which will, in its turn, produce a good yield of pure gas. The most injurious impurities are sulphur and phosphorus, both of which are liable to occur in the lime and coke and are ultimately found in the gas. In laboratory tests one pound of good commercial carbide will yield 5 cu. ft. of gas. It is the experience of the writer, however, that in actual service with commercial generators, there will be some losses due to occasional blowing off, loss of gas in charging and by solution in the water used, and other causes, and that it is safer to assume a yield of only 4 to 4.5 ft. per pound.

The gas itself is colorless, lighter than air, and when pure has only a slight and not unpleasant odor. It is condensed to a liquid only by a pressure of several hundred pounds. As made for service in the best commercial generators, it approaches closely to this standard, but the product of the poorest generators is contaminated with ill-smelling impurities and gradually deposits oily and tarry liquids. The choice of a generator is therefore a matter of importance.

Acetylene gas is, in the minds of many persons, still associated with the disastrous explosions which occurred during the early attempts to utilize the liquefied gas. Like all combustible gases, it forms explosive mixtures with air, but as now used, under moderate pressures and temperatures, the unmixed gas is not explosive. Acetylene has suffered at the hands of its over-zealous friends who have made extravagant claims for it, especially in the matter of candle power, which has often been much overstated. Careful tests which we have made show that a fair quality of gas, as produced under the conditions of actual service, will give a light of 33 to 35 candles per cubic foot per hour, when using burners of a capacity of one-half foot or over. If tested under the same conditions, smaller burners, for example, one-fourth foot, do not give quite as much light in proportion to the gas consumed. Acetylene is burned with somewhat higher pressure at the burner than with ordinary coal gas, a pressure of 22 to 25 tenths of an inch of water giving the best results.

A number of methods of utilizing acetylene for car lighting have been proposed. These may be classified, first of all, as compression and car generator methods. In the compression method, the gas is prepared in a stationary generating plant, purified, compressed and carried under pressure in cylinders under the car, in the same manner as Pintsch oil gas. From these cylinders the gas passes through a pressure reducing and regulating valve to the burners, as in the Pintsch system. In one compression system, which has been applied to a considerable number of cars, the car cylinders are charged at 150 lbs. pressure. To guard against excessive pressure or dangerous decomposition, should the apparatus become highly heated in wrecks or otherwise, the cylinders are made with rivetted and soldered seams and the pipes of fusible metal. The joints and pipes will then melt and allow the gas to escape quietly before the temperature of decomposition is reached. As to shock, direct experiments by several investigators have shown that at 150 lbs. there is no danger of decomposition or explosion.

In another compression system, it is proposed to charge the cylinders at only 50 lbs., and use ordinary caulked joints and iron pipe. In this case the gas must be heated to about 1,100 deg. F., before it attains a pressure of 150 lbs. Fusible plugs are provided for relief at high temperatures. Direct experiments have shown that at 50 lbs. cylinders may be heated to redness without explosion. Obviously, cylinders will hold only one-third as much gas at 50 as at 150 lbs., and either more storage capacity or more frequent charging will be required.

All compression systems have the disadvantage that cars must periodically return to charging stations. They have several advantages, however. The gas may be made slowly in large stationary generators and be thoroughly purified and dried. The apparatus on the car is of the simplest character and requires no attention from the trainmen except turning the gas on and off, while the labor of cleaning is reduced to the wiping of globes and shades and the occasional cleaning of burners.

A number of designers have brought out automatic generators to be placed directly on the car, to produce gas as needed. Automatic generators have been successfully operated for house lighting for a number of years, but these are not well adapted to car lighting, partly because they require too much space, and partly on account of details of design or construction which are either unsafe or unreliable when subjected to the vibration and shock incident to car service. Generators may be divided into two classes, those in which the water is added, a little at a time, to the carbide, and those in which small portions of carbide are thrown into a considerable volume of water. Obviously it is much simpler and easier to arrange an automatic feed of a liquid than of a solid, even if the latter is in a state of rather fine division. The liquid can be controlled by a balancing of pressures while for the solid some form of mechanism is necessary. Water feed generators were, therefore, first brought out.

The action of the water on the carbide is attended with the development of a considerable amount of heat and the temperature is especially liable to rise in water feed generators because so little water is present during the action, to absorb the heat. The residue of lime, left by the carbide after the evolution of the gas, is a very poor conductor of heat, a circumstance also favorable to the development of a high local temperature. On opening generators of this type while in operation, we have at times measured differences of temperature as great as 300 deg. within a space of 2 in. But high temperature at the point of generation is productive of gas which is impure and deficient in candle power. Inventors of water feed apparatus have therefore endeavored to secure as good regulation of the water as possible, and in the best generators have attained very good results in this particular. Another method of avoiding heating, which is frequently adopted, is the division of the charge of carbide into small portions, each of which is nearly exhausted before the next is attacked.

The water may be admitted at the top or bottom of the mass of carbide. In one generator which is in successful operation on several roads, the water is admitted at the top, from an elevated tank by means of a pipe passing first to the bottom of the apparatus, then turning upward to the top of the carbide holder. The gas passes out at the top of the same holder. This arrangement allows of the desired balance of pressure between the water and the gas. The carbide is divided into portions of 1½ lbs. contained in baskets arranged one above the other, in such a manner that only one basket is in action at a time, being fed by the overflow from the next higher basket. The baskets are placed in removable cartridges, and as the generator is made in two units, it may be operated continuously for an indefinite time by changing the cartridge in one unit while the other is working. The generator does not appear to attain a temperature sufficiently high to injure the gas. In another apparatus which has been recently devised the carbide is contained in a seamless steel pot which is partly immersed in a tank of water. The water reaches the carbide through a check valve and small orifice in the bottom of the pot, thus coming in contact first with the bottom of the charge of carbide. This arrangement permits a slow flow of the water, which is stopped by the pressure of the gas when the lights are turned off. The generator is the simplest one now on the market, and admits of cleaning and recharging with a minimum of time and labor.

Carbide feed generators have a large place in house lighting, where they give excellent service and very pure gas. They are less readily adapted to car lighting, however, and have not yet come into extensive use, although one or two designs have been presented which appear to be very well worked out. In generators of this type and of a size adapted to car lighting, 1 to 4 oz. of crushed carbide are dropped at a time into 10 to 25 gals. of water. The carbide feeding device is operated in proportion to the consumption of gas and is set in motion by a variety of means, such as the rise and fall of a gas storage bell, or of the water in a displacement tank, or directly by the rise and fall of the gas pressure itself. One maker uses a weight or spring motor which is stopped and started by the rise and fall of a bell. The carbide is contained in a closed hopper, and is discharged therefrom by various devices, such as screw convevors, sweeps which push the carbide off from a platform, valves of different kinds, or by horizontal or vertical wheels carrying pockets which are filled on one side and empty on the other. It is too early to decide which of these plans is best for a car generator. It is essential, however, that the parts move very freely, and be so arranged that they cannot be clogged by carbide. In generators of this class the charge of water should be one-half to one gallon for each pound of carbide. Less than the smaller amount produces a residue which does not flow out completely, and the generator runs hot. More than the larger quantity requires inconveniently large tanks and causes some waste of gas, for the reason that water will hold in solution its own volume of acetylene.

Generators which are provided with a floating storage bell work at a constant pressure corresponding to the weight of the bell, which is suitably adjusted. In all others the pressure is variable and regulating valves are necessary. Satisfactory valves are readily obtainable which will keep the pressure on the burners at any desired constant amount.

In nearly all cases the gas is moist as it leaves the generator, and as it is most convenient and safe to run the pipes on the outside of the car, the moisture must be removed or the pipes will be stopped by frost in cold weather. This is usually accomplished by passing the gas through cooling coils which drain back to the generator, and through a cylinder under the car, where the remaining moisture is deposited. In one generator we have introduced the modification of passing the gas through fresh carbide which absorbs the moisture very satisfactorily.

The quality of gas furnished by a generator may be readily judged by a few simple observations. The odor should not be strong or exceedingly offensive. The residue should be white or light gray. Yellow, brown or black residue indicates hot generation and inferior gas. Carbide feed generators should not run warmer than 110 deg. F., and water feed ones not higher than 140 deg.

In judging of generators the following points are important:

1. The generator should be substantially built, with as few joints as possible. Joints should not depend on solder alone. Brass and copper should not enter into the construction to any considerable extent.

2. A reliable automatic blowoff should be provided, which will relieve both over pressure and over generation of gas.

3. Generators should be entirely automatic and require no attention from trainmen except turning the gas on and off. When allowed to stand idle but fully charged, or when suddenly shut off while working at full load, the generator should not blow off.

4. The gas should be pure and cool as described above, and sufficiently dry to stand the coldest weather.

5. There should be enough storage capacity to take up all after-generation, and to allow charging and re-starting without the extinction of the lights by the air thereby introduced. Suitable cocks, preferably automatic, should be provided to prevent back flow of gas while charging.

6. Gage glasses whose breakage would allow the escape of gas should not be used. Flexible tubing, swing joints, springs, chains, pulleys, stuffing boxes and check valves are undesirable and should not be used where their failure will affect the safety or reliability of the apparatus.

7. Generators should have a carbide capacity of not less than 30 lbs., and an indicator showing at all times how much unused carbide remains.

8. Obviously, simplicity of construction and operation is very desirable.

It is to be remarked that all of the above specifications are not filled by any generator now on the market, although some approach it closelv and improvements are constantly being made.

The early progress of acetylene car lighting was hindered by the lack of suitable lamps and fittings. Old oil lamps and Pintsch gas lamps have been re-arranged with fair success. Now, however, at least two makers provide lamps especially designed for acetylene. The lamps should be so arranged that the gas is not heated before reaching the burners, the air supply should pass through without strong currents to cause flickering of the blaze, and the interior should be readily accessible. The arrangement and kind of reflectors, shades and globes are also important. A certain amount of reflection is desirable to avoid waste of light in the upper part of the car, and this may be obtained by white reflectors, as in Pintsch lamps or by ordinary white opaque shades of suitable outline. Etched or opaque globes cut down the total light radiated but give better distribution. Actual equipment of a car is the most satisfactory method of judging a given arrangement of lamps.

It is yet too early to make reliable estimates of all the items entering into the cost of acetylene lighting, as compared with other systems. The cost of equipment will vary according to circumstances, but the following is believed to be a fair estimate for a 60-ft. coach, provided with center, closet and vestibule lamps:

Oil	$253.00
Acetylene	459.70
Storage electricity	841.40
Combined electricity	580.00

In each case the labor of installing is included. For oil lighting six double "Acme" center lamps are provided for the center of the car. This is one more than is ordinarily used but is still too few to give as much total candle power as is furnished by the other systems. In the estimate for storage batteries is included a proportional amount for the charging station, also for reserve batteries. "Combined electricity" represents a baggage car dynamo system with a small storage battery auxiliary which supplies a portion of the lamps for a short time during the changing age of locomotives and other interruptions. This system is charged with the proper proportion of the baggage car plant on the assumption that the train consists of four coaches and the baggage car.

The cost of operating one car for five hours per day for one year is estimated as follows:

	Oil.	Acetylene.	Storage Electric.	Combined Electric.
Interest and depreciation	$27.83	$50.57	$160.79	$74.90
Fuel	55.60	155.48	31.25	31.25
Repairs and supplies	13.00	15.00	20.00	15.00
Attendance	17.00	15.00	35.00	53.32
Total	$113.43	$236.05	$247.04	$174.47

In the combined electric system the attendance charged is the extra pay received by the baggageman for that service. In neither electric system has any charge been made for auxiliary light for use in case of failure of the current. Such auxiliary is frequently but not universally used. Sufficient oil lamps for this purpose would cost about $85, but would add little to the cost of operation. The estimates are based as far as possible on actual practice and records. Obviously many of the items will vary somewhat on different roads, according to variations in the management of details. Thus the cost per car for the combined electric system decreases as the number of cars per train increases. In the storage system the cost of attendance and charging will vary in different places. In a system in which there are principal and auxiliary lights of quite different cost, the total cost will vary considerably according to the proportion of the time during which the auxiliary light burns.

In comparison with other modern systems of lighting, acetylene generated on the car has the advantage of complete independence of the cars of each other and of charging stations. The use of compressed gas or of storage batteries requires the periodical return of cars to charging stations. Electricity from a dynamo in the baggage car necessitates connections between cars, adding to the labor of making and breaking up trains, and also restricts the cars to trains having a dynamo baggage car. When only main line trains are so provided, cars which are set out for branch lines must depend upon auxiliary lights for the remainder of the trip. The dynamo requires some attention, which is easily given by the bag-

*Chemist, Chicago, Milwaukee and St. Paul Ry.

gageman on through trains, but not on local trains making frequent stops. A properly arranged acetylene system calls for no attention on the train except lighting and turning off the lights. On one road the acetylene lamps have been provided with electric igniters, thus allowing them to be lighted, even from a distance, merely by the turning of a key, as with electricity. For some special purposes, such as sleeping car berth lights and ventilating fans, the electric current is practically indispensable. The cost for attendance of acetylene lighting is not greater than that of oil lamps, and with some generators may be considerably less.

For solid through trains acetylene is not better or cheaper than electricity, although it compares favorably with that method of lighting. For suburban and other local trains acetylene is especially adapted. At present there are in this country 82 cars in operation or in process of equipment, five different systems of apparatus being represented.

TECHNICAL.

Manufacturing and Business.

The engines building at the Baldwin Locomotive Works for the Societe Miniere e. M. de p. are being equipped with improved Michigan lubricators and automatic steam chest plugs.

H. A. Higgins, General Manager of The Standard Tool Co., Cleveland, Ohio, sailed for England May 15, to visit the foreign representatives of his company in England, France, Germany, Russia and Scandinavia.

At the annual meeting of the stockholders of the Rome Locomotive & Machine Works the following were elected directors: H. S. Cooke, Charles H. T. Collis, William H. Kimball, of New York city, and T. H. Stryker, of Rome, N. Y.

Wm. B. Scaife & Sons, Pittsburgh, Pa., have a contract to design and erect the buildings for the new plant of the MacPherson Switch & Frog Co., at Niagara Falls, N. Y. Steel-frame construction will be used throughout.

The number of locomotives building by the Schenectady Works for the Northern Pacific and 53 locomotives building by the Richmond Locomotive Works for the Wabash will all be equipped with improved "Michigan" lubricators and automatic steam chest plugs.

The National Skylight & Construction Co., of New York, has secured a contract for the skylight work for the new shops of the Lake Shore & Michigan Southern at Collinwood, Ohio. About 71,000 sq. ft. of the company's steel puttyless system will be used.

The Sargent Co. held an election of officers on May 29, which resulted as follows: George M. Sargent, Chairman Board of Directors; W. S. Sargent, President; H. K. Gilbert, Vice-President and Treasurer; Day McBirney, Secretary. The company is planning a considerable extension to its present works at Chicago Heights, Ill.

The Railroad Supply Company, Chicago, has just acquired control of various patents issued to Frank A. Laudee, of Moline, Ill., for highway crossing signal apparatus and electric block signaling. The apparatus covered by these patents will be made and sold exclusively by the Railroad Supply Company. The patents are said to cover valuable and novel features in the art of electric signaling.

The American Blower Co., of Detroit, Mich., recently closed a contract for the entire heating, ventilating, drying and mechanical draft plants for the new works of the New York Glucose Co. at Shady Side, N. J. There are 14 heating plants and five starch drying plants. The heating apparatus constitutes a total of about 100,000 ft. of surface, 15 steel plate fans, varying in size from 80 in. to 140 in., and five large disc fans. There is also a 360 in. steel plate fan for the forced draft plant to provide the blast necessary for the proper combustion of nearly 50,000 lbs. of buckwheat anthracite coal an hour.

The Ingoldsby Automatic Car Co., St. Louis, Mo., as noted in our issue of June 14, has recently received an order for 315 of its dump cars, of 100,000 lbs. capacity, from the Colorado Fuel & Iron Co., and the American Smelting & Refining Co. These cars will be used to haul coal and ore. Of these, 280 will be wooden cars and 35 will be all-steel cars, built wholly of commercial shapes and plates. This order resulted directly from the satisfactory working of 40 cars in the service of the Crystal River Railroad. The Union Sand Co. has also placed an order for five Ingoldsby steel dump cars of 100,000 lbs. capacity to be used in the sand trade. Beside these recent orders, the company has contracts for building 1,500 dump cars.

Iron and Steel.

Henry Wick has resigned as President of the National Steel Co.

The Mexican Railway is reported making inquiries on 600 tons of 75-lb rails, 35,000 steel ties and 77,000 steel keys.

F. H. Kindl has resigned as Engineer of the Carnegie Steel Co., in charge of structural work, to take effect July 1.

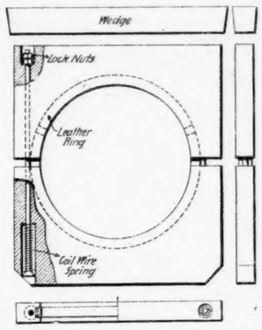
The Conemaugh Steel Co. has been incorporated in Pennsylvania with a capital stock of $50,000,000, by officers of the Cambria Steel Co.

The Tennessee Coal, Iron & Railroad Co. is dismantling the blast furnaces at Oxmoor, Ala., and removing the machinery to Ensley. The company has bought the steel, wire and nail mill of the Alabama Steel & Wire Co. at Ensley.

At the annual meeting of the Illinois Steel Company in Chicago last week four new directors were elected. A. C. Converse, P. Roberts, C. M. Schwab and T. W. Robinson were elected in place of C. C. Cuyler, N. Thayer, Robt. Bacon and H. H. Porter, resigned.

The Improved Harrison Dustguard.

The Harrison Dustguard Company, Toledo, Ohio, has recently improved its well-known dustguard, and we give herewith a sketch showing the changes that were made. The features that have won for it so much favor remain unchanged, and the springs are now in the lower half of the guard, thus protecting them from accumulation of sand or dirt which might prevent them from working properly. Lock nuts are used on the small spring bolts, and the leather packing ring is of the well-known pattern and material. The wedge strip which closes the aperture in the top of the box, above the guard, is now a simple unbroken surface of wood, and it is not necessary to counter-bore it for the accommodation of the guard bolts. The increased duty of journals that has come with the greater carrying capacity of cars, and also the higher average speed, has made the dustguard of greater importance than ever before, and its true value is becoming more appreciated. The makers of this dustguard have gone to much trouble to provide a guard that will keep sand out of both the top and the back of oil boxes, and be durable enough to be effective as long as other parts of the journal equipment will last. The guard is now used on more than 100 railroads, where it has been specified for all classes of modern cars and locomotives.



Service Record of Sessions-Standard Friction Draft Gear.

In the *Railroad Gazette*, Aug. 17, 1900, p. 550, we illustrated and described the Sessions-Standard Friction Draft Gear and gave results of some laboratory tests, and also of impact tests in road service. These tests showed very favorably for the device. Since that time regular service records have been taken on several railroads to determine the effect on draft and center sills, and the wear of friction pieces. Car No. 46,348, Central of New Jersey, 80,000 lbs. capacity, wooden frame, is one on which a test is being made. The draft gear was put on Feb. 20, 1901, and the car has since been in regular coal hauling service. On June 17, one of the malleable iron wedge-pointed barrel castings in which the draft springs are encased, was removed from this car. The wear of the friction pieces, from heel to point, was remarkably even for the abrasion of unlubricated metal surfaces, and so slight that the skin was not worn off of the casting at the lowest points of the friction planes. In the makeup of the trains, of which this car has been a part, it was always coupled first after the engine to give it the most severe pulling strain on draft gear. Its total mileage was 3,890. The draft sills and center sills showed no injury and all draft gear bolts were tight and intact. It is interesting to note that after a period of service such as this there was no apparent distortion of any part of the device, and that the complete operation of removing the old barrel casting and the springs and the application of the new casting and the springs, occupied but five minutes. The barrel casting from the Central of New Jersey car and others that have been in service for different lengths of time are to be seen at Saratoga during the conventions.

THE SCRAP HEAP.

Notes.

The track laborers of the Canadian Pacific have struck for an increase of about 10 cents a day in their pay. Press despatches from Montreal indicate that a demand for the recognition of the Trackmen's Union is a principal feature of the strike.

The convention of railroad commissioners which met at San Francisco the first week in June adopted a constitution and by-laws. This puts the organization on a permanent basis. Heretofore the question of continuing to hold the sessions year after year has had to be decided anew each year.

The freight trains of the Boston & Albany running between Springfield and Rensselaer (East Albany) are to have their runs extended over the New York Central to West Albany. It is said that the freight yard at Rensselaer is to be used by the New York Central, now controlling both roads, as a passenger train yard.

The principal railroads from the south which run trains into Ohio have, at the request of the Railroad Commissioner of that state, taken down the signs in their cars which designate certain space in trains for colored passengers and certain other space for white passengers. These signs, used in states which require separate cars for the different races, are now removed when a train enters Ohio and are restored when it returns to Kentucky or West Virginia.

The grand jury of Mercer County, N. J., at Trenton, has made a presentment censuring the Pennsylvania Railroad Company for contributing to the circumstances causing the butting collision near Bordentown on Feb. 21, where 17 persons were killed. The conductor, who did not correctly read his telegraphic order, is censured, but the jury believes that mitigating circumstances relieve him of criminal liability. The jurymen are in doubt whether or not the engineman of the second section of the westbound train gave the prescribed whistle signal when he passed the eastbound train.

It is announced that a package express business is soon to be established on the street railroad lines of New York City. The Metropolitan Express Company, which has a contract with the Metropolitan Street Railway, and in which the New York Electric Vehicle Transportation Company also appears to be interested, has 10 cars already equipped for running over the lines of the Metropolitan road in Manhattan and those of the Union Railway in the Borough of the Bronx. These cars will be propelled by underground trolley in Manhattan and by overhead trolley on the Union Company's lines. The cars will be run at night, when the passenger business is light. It is said that no cars will be run on Broadway.

Traffic Notes.

The New York, New Haven & Hartford is going to issue mileage books at two cents a mile for 500 miles. Heretofore the 1,000-mile book has been the smallest issued.

It is said that there are over 20 ticket brokers doing an active business in Buffalo, notwithstanding the fact that most of the excursion tickets sold to that city this year are of the personal-description contract form.

According to the *Common Carrier* the railroads south of the Potomac and east of the Mississippi have formed a weighing and inspection association, which will begin operations about July 1. The chief office will be at Atlanta and the Manager is to be Mr. H. W. Woolf.

The Wabash has put on a new night train between Chicago and Buffalo to run through in about 12 hours. This is shorter time than that made by the best trains of any of the other roads, and the reporters say that the passenger men are considerably exercised over the action of the Wabash.

Statistics published by the proprietors of the Lowry cotton baling process show that a freight car will carry nearly twice as many pounds of cotton put up in round bales as it will carry in ordinary square bales. The carload shipments over four roads to Houston for a number of months averaged for Lowry (round) bales 48,221 lbs. per car, and for square bales 26,773 lbs. The average revenue per car per mile is said to have been 92.3 cents in the one case and 47.3 cents in the other.

Zincre Wood Preservative Paint.

Through a misunderstanding, the advertisement of the United States Paint Company, which will be found in this issue, appeared last week under the name American Paint Company. The correct name and address of the manufacturers of "Zincre" is United States Paint Co., 15 Cortlandt street, New York, N. Y., U. S. A.

LOCOMOTIVE BUILDING.

The Missouri Pacific has ordered 25 locomotives from the Brooks Locomotive Works.

The Choctaw & Northern is having four engines built by the Baldwin Locomotive Works.

The Southwestern of Arizona is having one engine built by the Baldwin Locomotive Works.

The Illinois Central has ordered 15 moguls for December delivery from the Baldwin Locomotive Works.

The Chicago, Indianapolis & Louisville has ordered three switch, two passenger and four freight engines from the Brooks Locomotive Works.

The Indiana, Illinois & Iowa has ordered 10 locomotives from the Baldwin Locomotive Works instead of the Brooks Locomotive Works, as reported last week.

The Southern Indiana order with the Baldwin Locomotive Works, reported in our issue of June 14, calls for two 8-wheel passenger engines and two switchers. The 8-wheelers will weigh 113,000 lbs. with 72,500 lbs. on the drivers, 18 x 24-in. cylinders and 66-in. drivers, extended wagon-top boilers with a working pressure of 180 lbs., 246 tubes 2 in. in diam. and 12 ft. ¼ in. long, fire-boxes 78 $^{7}/_{16}$ in. long and 34⅜ in. wide, with a capacity for 4,000 gals. of water and 7 tons of coal. The switchers will have 20 x 24-in. cylinders and 52-in. drivers with a working steam pressure of 160 lbs. The specifications for all include Westinghouse brakes, Cook bell ringers, Monarch brake-beams, Tower couplers, U. S. headlights, Hancock inspirators, Jerome packings, Ashton safety valves, Leach sanding devices, Michigan sight-feed lubricators, French springs, Crosby steam gages, Gould steam heating equipment, Standard driving and truck wheel tires and McIntosh blow-off cocks.

CAR BUILDING.

The Chicago City Railway has ordered 120 cars from the St. Louis Car Co.

The Chicago & Northwestern is reported to be in the market for 200 drover cars.

The Northern Pacific has ordered 32 cabooses from the South Baltimore Car Works.

The Mexican Coal & Coke Co. is having 20 cars built by the American Car & Foundry Co.

The Michigan Carbon Works is having one freight car built by the American Car & Foundry Co.

The Florida East Coast is having 325 freight cars built by the Southern Car & Foundry Co.

The Wells Fargo Express Co. has ordered 10 express cars from the American Car & Foundry Co.

The Lake Shore & Michigan Southern, it is rumored, will soon be in the market for freight cars.

The American Car & Foundry Co. has received an order for 250 refrigerator cars for a private car line.

The San Pedro, Los Angeles & Salt Lake is reported to have ordered 15 passenger cars from the Pullman Co.

The New York Central & Hudson River is reported to have ordered 200 flat cars from the American Car & Foundry Co.

The Philadelphia & Reading has ordered 1,000 gondola and 100 flat cars of 100,000 lbs. capacity from the Pressed Steel Car Co.

The New Union Sand Co., of St. Louis, has ordered five Ingoldsby dump cars of 100,000 lbs. capacity from the Ingoldsby Automatic Car Co.

The Government Railways of Australia in New South Wales have ordered from the Pressed Steel Car Company, through that company's foreign agents, the Transportation Development Company, Inc., 250 steel gondola cars. These cars will be similar to those now in

use in Australia, except they will be all steel instead of wood.

The Southern Pacific order with the Pullman Co. calls for 30 chair cars, and that with the American Car & Foundry Co. for 20 coaches, all to measure 60 ft. long and 9 ft. 8 in. wide. The specifications for all include Sargent brake-shoes, Janney couplers, Forsyth curtain fixtures, Pantasote curtain material, Safety car lighting and heating apparatus, Morris journal box lids, Pintsch light, Standard platforms and Hale & Kilburn seats.

BRIDGE BUILDING.

AKRON, OHIO.—The time is extended to June 22 for submitting bids to W. A. Durand, Clerk, Board of City Commissioners, for the Cherry street bridge. General plans are on file with J. W. Payne, City Engineer. (May 17, p. 340.)

ATCHISON, KAN.—Fred Giddings, City Engineer, is making plans for a 700-ft. viaduct over the tracks at Seventh street.

AUSTELL, GA.—Bids are wanted, June 24, for a 118-ft. combination bridge over Sweetwater, near here. Address J. M. Ganir, Clerk County Court, Marietta, Ga.

BAY CITY, TEXAS.—A vote will soon be taken on an issue of $40,000 for a bridge over Colorado River.

BENWOOD, W. VA.—The War Department has ordered the Baltimore & Ohio R. R. to remove one pier of its bridge in the Ohio River between Benwood & Bellaire. Some time ago it was given out that this bridge would be replaced.

BOUCHETTE, QUE.—See Lake St. Mary, Que.

BRICE, OHIO.—County Surveyor Harry Mastzel informs us that bids are wanted, by the Auditor, at Columbus, July 12, for a steel bridge on 150-ft. skew, over Black Lick Creek, near Brice station. It will be Pratt truss span with plank floor on steel joists.

BRIGHTON, COLO.—The County Commissioners have rejected the bids for a bridge over the Platte River at Brighton. It is to be a steel bridge about 300 ft. long (two spans) to conform to Cooper's Class C specifications. Address the County Clerk at Denver. Wm. D. Richardson is County Surveyor.

BURLINGTON, N. C.—Bids are wanted, July 8, by the Board of County Commissioners for a steel bridge over Haw River at Glen Cove Mills, near Burlington.

CAMBRIDGE, OHIO.—We are told that bids are wanted, some time in July, for a steel bridge of 110 ft. over Willis Creek. Address County Commissioners at this place.

CANTON, OHIO.—Bids are wanted, July 8, by J. B. Summer, Chairman Board of County Commissioners, for a stone arch bridge over Graham Creek two miles north of Canton.

CALHOUN, GA.—The County Commissioners are reported to have decided on a site for a bridge over Oostanaula River at Gorden's Ferry. T. W. Harbin, Clerk.

DES MOINES, IOWA.—New bids will soon be wanted for a Melan arch bridge over the Des Moines River at East Sixth street. It will have three 100-ft. spans. Geo. M. King, City Engineer, made the plans.

DETROIT, MICH.—The State Senate has passed a bill to permit the city to build a bridge over the American Channel of the Detroit River to Belle Isle.

DREHERSVILLE, PA.—Bids are wanted, by the County Commissioners, June 26, for a steel highway bridge over Little Schuylkill River.

FALMOUTH, VA.—Bids are wanted, on June 24, by the Board of Supervisors, at Stafford, for a steel bridge over Fall Run.

FORT GIBSON, IND. T.—A franchise, according to report, is granted to Wm. T. Hutchings, of Muscogee, Ind. T., and others, for a toll bridge over Arkansas River. Cost reported to be $125,000.

FREDERICTON, N. B.—The Commissioner of Public Works wants bids for several bridges, including steel superstructure of Oak Bay bridge, Charlotte County.

GRACEFIELD, QUE.—See Lake St. Mary, Que.

GUELPH, ONT.—J. Hutcheon is receiving tenders for a steel bridge over River Speed, on the town line between Guelph and Eramosa townships.

HATTIESBURG, MISS.—The Mobile, Jackson & Kansas City will build a bridge over Leaf River at a cost of about $100,000.

HEIDELBURG, ONT.—The Council has decided to replace the bridge across the Nith River, known as the Risser bridge, with an iron structure.

IRON CITY, TENN.—Contracts will be let, June 24, at Iron City, by the Bridge Committee, for a steel bridge over Shoal Creek. The county is considering two bridges, one at Iron City and another at Wayland Springs, the former to be 440 ft., and the latter 220 ft. It is not decided which bridge will be let at the present time. F. M. Cannon, Lawrenceburg, is Chairman of the Committee.

JAMESTOWN, N. DAK.—Bids will be received, until July 1, by L. B. Niemeyer, County Auditor, for a bridge over the Pipestem River southwest of Pingree. Plans are on file with the Auditor.

LAKE ST. MARY, QUE.—The Quebec Government is considering building three bridges over the Gatineau River in Ottawa County, one to be located at Lake St. Mary, another at Gracefield and a third near Bouchette. A bridge is also proposed over St. Joseph River.

LONDON, ONT.—Mr. M. Grant, Clerk of London township, is receiving tenders for two steel bridges. Plans at office of F. B. Talbot, county buildings, this city.

MCRAE, GA.—Wm. McLean, Clerk, County Commissioners, writes us that the Commissioners want estimates on a combination highway bridge about 1,100 ft. long over Green Swamp near this town. Bids will be wanted on Aug. 5 by Mr. McLean at McRae.

MIAMISBURG, OHIO.—We are told that bids are wanted, July 6, for a steel bridge over Miami River. Address A. G. Feight, County Auditor at Dayton.

MILWAUKEE, WIS.—The Council has ordered a bridge at Second avenue. Cost, about $5,000, as estimated by City Engineer Charles J. Poetsch.

MONTICELLO, MO.—Bids are wanted, June 24, for three bridges. Geo. H. Robert, County Commissioner.

MORGANTOWN, N. C.—We are told that bids are wanted at once by W. B. Berry, at Chesterfield, N. C., for two bridges over Catawba River for Burke County.

NORRISTOWN, PA.—Viewers have reported favorably for a bridge over Stony Creek at Markley street, this place. Estimated cost, $13,500.

OGDEN, MICH.—George L. Porter, of Victorsville, is receiving bids for two steel bridges, one of 30 ft. and one of 50 ft.

OGLETHORPE, GA.—Bids are wanted, July 23, according to report, for a steel bridge. A. H. Perry, clerk.

OIL CITY, PA.—The Oil City, Rouseville & Franklin R. R. wants bids, until July 8, for a steel bridge of six spans over the Allegheny River.

PEKIN, ILL.—We are told that bids are wanted now for some steel bridges for Tazewell County. Address S. S. Smith, at Mackinaw, Ill.

PITTSBURGH, PA.—According to Pittsburgh reports, contracts will soon be let for the steel bridge across the Monongahela River at Ferry street, for the Pittsburgh, Toledo & Western, which will be the Pittsburgh end of the Wabash R. R. A. P. Bollar, of Bollar & Hodge, No. 1 Nassau street, New York, is the engineer.

Director of the Department of Public Works E. M. Bigelow is reported as saying that he will soon advertise for bids for rebuilding the Lincoln avenue bridge, for which plans have been made for over a year. The estimated cost is $165,000. (May 3, p. 306.)

It is probable that Director Bigelow will also soon advertise for bids for building the Wilmot street bridge, which is estimated to cost $160,000.

The grand jury has recommended that a bridge be built by the counties of Allegheny and Beaver over Big Sewickley creek, near Merriman's run, between Sewickley township, and Economy township, Beaver county.

QUINCY, MASS.—The Council has appropriated $2,600 for a steel footbridge over the tracks of the Consolidated Road at Warren avenue.

RUMFORD FALLS, ME.—The County Commissioners will give a hearing, on June 27, on the petition of the towns of Rumford and Mexico for the location of a road and bridge over Swift River. A steel bridge of 150-ft. span will be required.

SACKVILLE, N. B.—Surveys are reported being made by the Government Engineer for a site for a new bridge over River Tantramar.

ST. THOMAS, ONT.—Elgin County Council have decided in favor of building a steel bridge at the Muncey site; probable cost, $18,000.

SOUTH BEND, IND.—The County Commissioners want bids, until 9 a. m., June 24, for five iron bridges, two culverts and moving one iron bridge to new location. Plans with John M. Brown, Auditor.

Separate bids are wanted by the Commissioners at 9 a. m., July 8, for an iron bridge with stone abutments, over Bowman Creek at Michigan street. Plans are with John M. Brown, Auditor, South Bend. Michigan street is 100 ft. wide.

TERRE HAUTE, IND.—We are told that bids will be wanted in about two weeks by the Commissioners of Vigo County, for a steel bridge over Wabash River, which will cost between $175,000 and $200,000. It will be about 880 ft. long, divided into eight spans, five of 120 ft., two of 100 ft., and one 80-ft. movable span. The roadway will be 36 ft. wide with two electric car tracks, and there will be two 8-ft. walks. The roadway will be brick pavement and the walks concrete. Prof. M. A. Howe and J. E. Starbuck are the engineers.

TIPTON, IND.—We are told that bids will be wanted some time in July for 10 steel bridges varying in size from 20 ft. to 35 ft. E. Perry, Auditor of Tipton County, will receive the bids.

URBANA, ILL.—On June 25, at 1 p. m., at the County Clerk's office, contracts will be awarded for two 60-ft. highway bridges on stone masonry. Specifications may be had of Ira O. Baker, Champaign, Ill.

WELLINGTON, KAN.—The County Commissioners will soon open bids for the Adams street bridge over Bluff Creek.

WEST CLAREMONT, N. H.—A steel bridge will be built over Sugar River at a cost of $8,000. Francis F. Haskeil, Town Clerk.

WESTMINSTER, VT.—The Boston & Maine will abolish two highway crossings in this town. Plans are approved by the Railroad Commissioners.

WETUMPKA, ALA.—The Montgomery Northern Ry. reported organized by James A. Kelly, of this place, and others, will need a bridge over the Tallapoosa River, near Wetumpka.

WHEELING, W. VA.—The Tennessee & North Carolina R. R., we are told, wants a steel bridge of about 200 ft. over Pigeon River, in Tennessee, as soon as possible. J. J. Holloway, of Wheeling, is President.

Other Structures.

BENTON HARBOR, MICH.—The Benton Harbor Terminal Ry. Co. has been incorporated in Michigan, to build a depot and terminal facilities in Benton Harbor. A. A. Patterson, Jr., and Joseph W. Johnston, of Benton Harbor, are interested.

BREMERTON, WASH.—Proposals will be received at the Bureau of Yards and Docks, Navy Department, Washington, until 1 o'clock, June 29, for constructing a brick and steel building about 43 x 50 ft. at the Naval Station, Bremerton, Wash. For plans, specifications, etc., address "Commandant, Naval Station, Bremerton, Wash."

MARQUETTE, MICH.—The Duluth, South Shore & Atlantic has let a contract to David Hood for the new passenger station in Marquette.

NEW ORLEANS, LA.—It is reported that plans are being made for a union station in New Orleans.

NEW YORK, N. Y.—Plans are under consideration at the War Department for enlarging Governor's Island, toward which the last Congress appropriated $260,000, of which $200,000 is to be expended by the Army Engineers. The entire improvement contemplated, including sea walls, piers, and a warehouse, will cost $1,500,000.

PITTSBURGH, PA.—Plans are reported being made for a large wire nail plant in which T. W. Fitch, of the Pittsburgh Steel Shafting Co., is interested.

SUMTER, S. C.—Arrangements are reported being made for building a new passenger station on the Atlantic Coast Line at Sumter.

WASHINGTON, D. C.—Proposals will be received at the Bureau of Yards and Docks, Navy Department, Washington, until 1 o'clock, June 22, for the structural steel work for a roof over the Forge Shop, Navy Yard, Washington, D. C. Address "Commandant, Navy Yard.

MEETINGS AND ANNOUNCEMENTS.

(For dates of conventions and regular meetings of railroad associations and engineering societies see advertising page xxi.)

Railroad Surgeons.

The International Association of Railway Surgeons held its annual meeting at Milwaukee last week. Dr. Rhette Good, of Mobile, Ala., was chosen President for the ensuing year, and Dr. J. L. Mitchell, of Chicago, was re-elected Secretary.

Master Car Builders' Convention.

The first session of the Thirty-fifth Annual Convention of the Master Car Builders' Association will be called to order at 10 a. m. on Monday, June 24, at Saratoga, N. Y. The Rules of Interchange will be revised immediately after the opening exercises, the discussion of topical questions being omitted from the first day's work. On the two following days the reading and discussing of questions propounded by members is the special order at 12 o'clock noon of each day. The subjects for topical discussion, as prepared by the committee, are as follows:

1. What constitutes efficient waste packing? To be opened by Mr. F. A. Delano.
2. Release rigging for couplers? To be opened by Mr. D. F. Crawford.
3. Advisability of increasing the train line pressure on loaded cars? To be opened by Mr. A. L. Humphrey.
4. Will it be advisable to adopt a tonnage rating for representation in the Master Car Builders' Association? If so, why? To be opened by Mr. J. S. Lentz.
5. Cause of defective and worn-out M. C. B. couplers due to worn pins and pinholes rather than to worn faces of knuckles and sprung guard arms. Remedies for? To be opened by Mr. W. C. Squire.
6. Cannot the general work of car inspectors be improved by giving mores attention to the eyesight, hearing, etc., of the men? To be opened by Mr. G. W. Rhodes.
7. Turning and rolling journals. To be opened by Mr. D. F. Crawford.
8. Are there any objections to splicing all sills of long passenger car equipment? If not, how should this be done according to the best modern practice? To be opened by Mr. H. M. Pflager.

Under the head of "Reports of Committees" will come the reports of the following standing committees:

Arbitration.—John Mackenzie, Chairman; W. W. Atterbury, S. P. Bush, P. H. Peck and J. N. Barr.

Supervision of Standards and Recommended Practice. —A. M. Waitt, Chairman; T. W. Demarest and Wm. Apps.

Triple Valve Tests.—G. W. Rhodes, Chairman; A. W. Gibbs, J. O. Pattee, W. S. Morris and Wm. McIntosh.

Brake Shoe Tests.—S. P. Bush, Chairman; George Gibbs and R. P. C. Sanderson.

Prices in M. C. B. Rules.—J. N. Barr, Chairman; C. A. Schroyer, J. H. McConnell, W. E. Symons and T. B. Purves, Jr.

Tests of M. C. B. Couplers.—W. W. Atterbury, Chairman; W. P. Appleyard, F. A. Delano, W. S. Morris and H. Monkhouse.

The committees appointed to report at this convention are as follows:

1.—Revision of Recommended Practice for Springs, including Design for Springs for 100,000-pound Cars.—Charles Lindstrom, Chairman; R. P. C. Sanderson and A. G. Steinbrenner.

2.—Uniform Section of Siding and Flooring.—R. P. C. Sanderson, Chairman; W. P. Appleyard and J. S. Lentz.

3.—Draft Gear.—E. D. Bronner, Chairman; G. F. Wilson, Mord Roberts, T. A. Lawes and C. M. Mendenhall.

4.—Side Bearings and Center Plates.—B. Haskell, Chairman; H. M. Pflager, T. W. Demarest, J. W. Luttrell and W. H. Marshall.

5.—The Chemical Composition of All Steel Car Axles. —E. D. Nelson, Chairman; F. A. Delano and C. A. Schroyer.

6.—Cast Iron Wheels.—J. N. Barr, Chairman; Wm. Garstang, D. F. Crawford, J. J. Hennessey and Wm. Apps.

7.—Index of Proceedings.—F. A. Delano, Chairman; D. F. Crawford and W. A. Nettleton.

8.—Air-Brake Hose Specifications.—James Macbeth, Chairman; H. F. Ball and R. N. Durborow.

9.—Subjects.—Samuel Higgins, Chairman; W. A. Nettleton and A. E. Mitchell.

10.—Establishment of Library in Connection with the American Railway Master Mechanics' Association.—J. T. Chamberlain.

11.—Revision of Rules for Loading Long Materials.—F. D. Casanave, Chairman; S. F. Prince, Jr., W. P. Appleyard, P. Leeds, J. N. Barr, S. Higgins, W. H. Thomas and A. M. Waitt.

PERSONAL.

(For other personal mention see Elections and Appointments.)

—Mr. F. M. Hawkins, who recently resigned as Auditor of the Waycross Air Line Railroad, has been appointed General Manager of The Satilla Manufacturing Company of Waycross, Ga.

—A brief sketch of the life of Mr. George L. Peck, whose appointment as General Manager of the Pennsylvania Lines West we noted last week (page 421), will be found in our issue of Jan. 18, page 51.

—There have been many expressions of regret at the absence of Mr. R. H. Soule from the conventions this year, because of his serious illness. Mr. Soule's friends (meaning everybody) will be glad to learn that he is now steadily improving in health.

—Mr. Abdiel W. Eichelberger died June 13 at Hanover, Pa., aged 82 years. He was a native of Hanover, and began his railroad career in 1852 as President of the Hanover Branch. At the time of his death Mr. Eichelberger was President of the Berlin Branch.

—Mr. J. A. McCrea, who, on June 7 last, became Superintendent of the Cincinnati Division of the Pennsylvania Company (Southwest System), was born May 26, 1875. He was graduated from Yale University in 1895 and entered railroad service the same year as a rodman on the Pennsylvania Company. Two years later he became Assistant Engineer of the Eastern Division and in August, 1899, he was appointed Engineer of Maintenance of Way of the same lines.

—Mr. David W. Ross, recently appointed Purchasing Agent of the Illinois Central, was born at Mineral Point, Wis., Nov. 9, 1869. He entered the service of the Illinois Central in 1888 as a stenographer in the telegraph department. In 1889 he was appointed Secretary to the General Superintendent. In September of the same year he became Secretary to the General Manager, then two years later Secretary to the Assistant to the President, and in 1892 Secretary to J. T. Harahan, Second Vice-President. Mr. Ross received his new appointment as Purchasing Agent on June 1, last.

—Mr. Charles W. Bein, Traffic Manager of the Southern Pacific (Atlantic System), died June 12. Mr. Bein began his railroad service as a rate clerk on the Morgan's Louisiana & Texas, and passed through the various grades in the general office of the Southern Pacific Company as a rate clerk, Assistant General Freight Agent of the Atlantic System, General Freight Agent of the same system, and in 1893 became Traffic Manager of the Galveston, Harrisburg & San Antonio. Mr. Bein was appointed to the position, which he held at the time of his death, that of Traffic Manager of the Southern Pacific Company (Atlantic System), on March 28, 1898.

—Mr. C. M. Burt, General Passenger Agent of the

Central Railroad of New Jersey, was born Dec. 4, 1862. He began his railroad service in 1879 in the auditing office of the New York, Pennsylvania & Ohio as a clerk. In 1883 he was connected with the Quartermaster's Department of the United States Army at St. Louis. In January, 1896, Mr. Burt was made Chief Clerk in charge of the passenger department of the Joint Traffic Association, and remained with this company until 1899, and in July of that year was appointed General Passenger Agent of the Fitchburg. Upon the lease of the Fitchburg to the Boston & Maine he was made Assistant General Passenger Agent of the last named company, remaining there until his recent appointment as General Passenger Agent of the Central Railroad of New Jersey.

—Mr. E. H. Utley, who on June 11 was appointed General Manager of the Bessemer & Lake Erie, was born March 18, 1850, at Wadsworth, Ohio, and began his railroad service as a station agent for the Chicago, Milwaukee & St. Paul. He resigned from this company in 1869 to become telegraph operator for the Pacific & Atlantic Telegraph Company at Philadelphia. From 1873 to 1875 he was operator in the Superintendent's office of the Chicago, Milwaukee & St. Paul. For three years (1877-1880) Mr. Utley was Secretary of the Allegheny Valley, and in April of the last named year became General Freight Agent, and was later given the General Passenger Agency. In 1897 he was appointed General Freight and Passenger Agent of the Pittsburgh, Bessemer & Lake Erie, now known as the Bessemer & Lake Erie.

—Mr. Thomas Curtis Clarke died at his home in the city of New York last Saturday night, after an illness of about two weeks. In our issue of Jan. 17, 1896, appeared a short sketch of Mr. Clarke's life and work, together with a portrait, these having been published on the occasion of his election as President of the American Society of Civil Engineers, and from the sketch there published we take a few notes. He was born in Newton, Mass., Sept. 16, 1827, and was graduated from Harvard in the class of 1848. The unusual intellectual activity which he always displayed was foreshadowed by the fact that he was the class poet. His brother, the Rev. James Freeman Clarke, was one of the most distinguished divines that our country has produced, and another brother, W. H. Clarke, was a civil engineer, highly esteemed. Mr. T. C. Clarke added further lustre to the name. He made special studies in civil engineering under Capt. John Childe, of Springfield, Mass., and spent a number of years on railroad work on the Grand Trunk, but early made bridge work his specialty. One of his first bridges was the second railroad bridge across the Mississippi River, that of the Chicago, Burlington & Quincy at Quincy, Ill. This was not only designed by Mr. Clarke, but was built by him without the intervention of contractors, except for the iron work. Mr. Clarke was the senior partner in the firm of Clarke, Reeves & Co., of Phoenixville, later the Phoenix Bridge Company. He was also one of the original members of the Union Bridge Company. These two companies built a number of famous bridges, one of them being the Kinzua Viaduct, another the Hawkesbury bridge at Sydney, New South Wales, another the bridge across the Hudson river at Poughkeepsie. In fact, Mr. Clarke used to say that he had been closely concerned in the building of over 80 miles of bridges and viaducts. At the time of his death he was acting as one of the Board of Experts for the improvement of the Manhattan terminal of the Brooklyn Bridge. Mr. Clarke had been an unusually industrious writer of engineering monographs. His papers appear in the Transactions of the American Society of Civil Engineers and of the Institution of Civil Engineers, from which latter body he received the Telford medal and also the Telford premium for papers contributed. He had served the American Society of Civil Engineers in various offices, having been its President in 1896. He was a member of various other scientific bodies, of the Century Club in New York and the Union Club in Boston. Mr. Clarke was a man of uncommon physical as well as intellectual vigor and of great fertility and activity. The endurance of his energies in unusual vigor to the time of his death was due probably in the main to the inheritance of a fine physique, but it was doubtless partly due to the intelligent and systematic care which he took of himself. Although he worked industriously he was fond of outdoor sports and was temperate almost to abstemiousness. Mr. Clarke's varied interests and his reliable courtesy and geniality made for him an unusual list of personal friends, and when we say that his death will be widely and deeply regretted we do not say this in a perfunctory way.

ELECTIONS AND APPOINTMENTS.

Baltimore & Ohio.—We are officially informed that J. N. Barr, Mechanical Superintendent, expects to remain in his present position. This, of course, dispels the various newspaper reports which stated that Mr. Barr was to go with the Chicago, Milwaukee & St. Paul.

Baltimore & Ohio Southwestern.—The position of Assistant General Passenger Agent, held by the late G. B. Warfel, has been abolished.

Boston & Albany.—It is commonly reported, but not officially confirmed, that Edgar Van Etten, recently appointed Second Vice-President of the New York Central & Hudson River, will soon assume charge of the operations of the B. & A., and that William Bliss, President of the B. & A., will retire from active railroad service.

Canadian Pacific.—W. R. MacInnes, heretofore General Freight Agent of the Western Division, has been appointed Assistant Freight Traffic Manager in charge of the Western Lines, with headquarters at Winnipeg, Man. W. B. Bulling, Jr., heretofore General Freight Agent of the Eastern Division, has been appointed Assistant Freight Traffic Manager, in charge of the Eastern Lines, with headquarters at Montreal, Que., effective July 1. Mr. Bulling is succeeded as General Freight Agent by S. P. Howard, heretofore Assistant General Freight Agent of the Eastern Division. W. B. Lanigan, heretofore Assistant General Freight Agent of the Ontario & Quebec Division (Lines West), has been appointed Assistant General Freight Agent of the Western Division, succeeding G. H. Shaw.

Canadian Northern.—G. H. Shaw, heretofore Assistant General Freight Agent of the Western Division of the Canadian Pacific, has been appointed Traffic Manager of the C. N.

Chatham & Lebanon Valley.—At a meeting, held June 13, W. S. Webb was elected President, succeeding W. C. Roberts, resigned.

Chicago & Northwestern.—Eugene E. Osborn was, on June 6, elected Vice-President and Secretary, succeeding M. L. Sykes, resigned.

Chicago Great Western.—A. G. Briggs has been appointed General Attorney, succeeding D. W. Lawler, resigned, effective June 15.

Chicago, Milwaukee & St. Paul.—A. E. Manchester, heretofore Assistant Superintendent of Motive Power, has been appointed Superintendent of Motive Power, succeeding S. P. Bush.

Choctaw, Oklahoma & Gulf.—J. F. Holden, Traffic Manager, has been appointed Second Vice-President also.

Cincinnati, Portsmouth & Virginia.—J. C. Gleason, Assistant Superintendent, with headquarters at Cincinnati, Ohio, has resigned.

Cleveland, Cincinnati, Chicago & St. Louis.—H. H. Eggleston has been appointed Supervisor of Bridges and Buildings, with headquarters at Union City, Ind.

Davenport, Rock Island & Northwestern.—E. F. Potter, heretofore Chief Engineer, has been appointed General Manager, succeeding E. E. Hughes, effective June 15.

Dayton & Faunsdale.—The officers of this company, referred to in the Construction column, are: J. J. King, Demopolis, Ala.; Vice-President, William Grant; Secretary; W. C. Epps; Treasurer, M. A. Myers, Selma.

Detroit Southern—J. C. Gleason, heretofore Assistant Superintendent of the Cincinnati, Portsmouth & Virginia, has been appointed Division Superintendent of the D. S.

Greenwich & Johnsonville.—Clarence B. Vorce, a civil and consulting engineer at Hartford, Conn., has been made Chief Engineer and will build the extension referred to in the Construction column.

Kansas City Northwestern.—G. W. Inge has been appointed Superintendent, with headquarters at Kansas City, Kan., succeeding R. E. Cahill. (See Missouri Pacific.)

Lake Shore & Michigan Southern.—A. H. Smith, heretofore Assistant General Superintendent, has been appointed General Superintendent, succeeding P. S. Blodgett, resigned. (See New York Central & Hudson River.)

Missouri, Kansas & Texas.—A. D. Bethard, heretofore Division Superintendent of the Missouri, Kansas & Texas of Texas, has been appointed Superintendent of Car Service of the M., K. & T., succeeding E. M. Collins, assigned to other duties.

A. J. Miller has been appointed Acting Purchasing Agent, succeeding C. N. Stevens, Purchasing Agent, deceased.

Missouri Pacific.—Owing to continued ill health, L. L. Keller, Division Superintendent, with headquarters at Nevada, Mo., has resigned. R. E. Cahill, heretofore Superintendent of the Kansas City Northwestern, succeeds Mr. Keller at Nevada.

Nevada-California-Oregon.—J. H. Bennet, heretofore General Freight and Passenger Agent, has been appointed Traffic Manager and the position formerly held by Mr. Bennet has been abolished.

New York Central & Hudson River.—P. S. Blodgett, heretofore General Superintendent of the Lake Shore & Michigan Southern, has been appointed General Superintendent of the N. Y. C. & H. R., succeeding E. Van Etten, assigned to other service. (p. 389.) Effective June 17.

Pittsburgh & Western.—L. F. Loree, President of the Baltimore & Ohio, has been appointed Receiver of the P. & W., succeeding J. K. Cowen, resigned.

Pennsylvania Company.—A. H. Sanford, heretofore Engineer Maintenance of Way of the Southwest System, at Louisville, Ky., has been transferred as Engineer Maintenance of Way, with headquarters at Logansport, Ind. Paul Jones, Engineer Maintenance of Way at Richmond, Ind., succeeds Mr. Sanford at Louisville, Ky. F. H. Worthington, Engineer Maintenance of Way at Indianapolis, Ind., succeeds Mr. Jones at Richmond, Ind., and Mr. Worthington, in turn, is succeeded by H. E. Newcomet, heretofore Assistant Engineer at Cincinnati, Ohio. W. B. Wood, heretofore Engineer Maintenance of Way of the Northwest System, will succeed Mr. Hamilton as Engineer Maintenance of Way, same System, with headquarters at Wellsville, Ohio.

Red Fork & Shawnee Coal & Railway.—The officers of this company, referred to in the Construction column, are: President, Freeman J. Short, Chicago; First Vice-President, J. W. Hockaday, Stroud, Okla. T.; Second Vice-President and General Manager, L. D. Lewis, Tulsa; Secretary, George R. Brobeck, Tulsa; General Attorney, N. W. Bliss, Chicago; Treasurer, Edward Short, Chicago.

St. Louis, Iron Mountain & Southern (Missouri Pacific).—William Cotter, heretofore Division Superintendent of the Grand Trunk, has been appointed General Superintendent of the St. L., I. M. & S., effective June 4.

Tennessee Coal, Iron & Railroad.—James Bowron, Vice-President; Second Vice-President A. M. Shook and Secretary J. F. Fletcher have resigned.

Terminal R. R. Association of St. Louis.—Robert Moore has been appointed Consulting Engineer.

Toledo, St. Louis & Western.—The office of Chief Roadmaster has been created with Stanley Millard in charge, with headquarters at Frankfort, Ind. He will have charge of the maintenance of tracks and will report to the Chief Engineer. The position of Engineer Maintenance of Way has been abolished, effective June 18.

Vandalia Line.—A. M. Underhill, heretofore Engineer Maintenance of Way of the Peoria Division, has been appointed Engineer Maintenance of Way of the Main Line, succeeding W. C. Downing (p. 421), and Mr. Underhill in turn is succeeded by E. L. Shaneberger, heretofore Assistant Engineer Maintenance of Way.

RAILROAD CONSTRUCTION.

New Incorporations, Surveys, Etc.

ALABAMA ROADS.—A number of men of Alabama and Mississippi are trying to secure the rebuilding of the Narkeeta road from Gainesville southwest to Meridian, Miss. Among those interested are Mayor Cochrane, of Tuscaloosa, and L. D. Godfrey, Jr., and Jacob Shifman, of Gainesville.

ALASKA & SIBERIA RAILWAY & NAVIGATION.—Capt. John Healey, according to Seattle reports, has gone to London to complete the organization of this company, part of whose plan is to build from Valdes, Alaska, via Port Clarence, Nome and the Norton Sound districts to the Behring coast. Senator W. A. Clark, of Montana, and A. J. Earling, President of the Chicago, Milwaukee & St. Paul, are reported interested. James Hamilton Lewis, of Seattle, is to be Second Vice-President.

ALPENA & WESTERN (ELECTRIC).—Surveys are about one-half completed for this line from Alpena, Mich., west via Gaylord, Mancelona and Traverse City to Frankfort. Surveys will soon be resumed. Albert Cousen, 342 Gratiot avenue, Detroit, is President. (Construction Supplement, March 8, 1901.)

ATCHISON, TOPEKA & SANTA FE.—Surveys are reported in progress for a branch from Navasota, Texas, on the Gulf, Colorado & Santa Fe to run northeast about 10 miles to Anderson.

BALTIMORE, WESTMINSTER & GETTYSBURG (ELECTRIC).—This company has been granted a franchise under the new law in Pennsylvania, to build a continuous trolley from Baltimore to points in Southern Pennsylvania. The incorporators are: L. A. Sweigard, T. E. Durham and W. H. Bartlett, of Philadelphia, and Charles E. Fink, of Maryland.

BEAR GULCH RAILWAY & CONSOLIDATED MINING & SMELTING.—This company has been organized in Spokane, Wash., to build a line from Jardine to Horr, Mont., to develop mines in the Bear Gulch section. Harry Bush, of Spokane, is Manager.

BENTON HARBOR TERMINAL.—This company has been incorporated in Michigan, with a capital stock of \$500,000, to build a station and terminals at Benton Harbor. A. A. Patterson, Jr., President of the Milwaukee, Benton Harbor & Columbus Ry., Benton Harbor, Mich., is a director.

BIRMINGHAM, SELMA & NEW ORLEANS.—Contracts are reported let for an extension of 27 miles from the present terminus in Marengo County, Ala. The company has been building an extension from Martin Station west 20 miles to Thomaston. (June 7, p. 389.)

BITUMINOUS STREET RAILWAY OF CLEARFIELD (ELECTRIC).—This company was incorporated in Pennsylvania June 14, with a capital stock of \$180,000, to build a line 34 miles long to connect Clearfield with Dubois, Falls Creek and other points in Clearfield County. The incorporators are: George A. Lukehart, Dubois, president; W. A. Engleman, J. B. Hess, J. A. Vasbinder, Dubois; John M. Ury, Clearfield; J. N. Langhom, Indiana, and John F. Warner, Philadelphia.

BLACKWELL, ENID & SOUTHWESTERN.—Contracts are reported let for the section to Cordell, Washitaw County, Okla. T., to be completed by Jan. 1, 1902. (May 31, p. 373.)

BRITISH COLUMBIA ROADS.—Consul Smith writes from Victoria, May 16, that the Legislature of British Columbia has authorized a loan of \$5,000,000, half a million of which is to be used in building a bridge across the Frazer River at New Westminster, and the remainder to be granted as a bonus at the rate of \$4,000 a mile, for the following roads:

From the coast near Point Roberts to Midway, Boundary Creek district, about 330 miles.

From the present terminus of the Esquimalt & Nanaimo to the northern end of Vancouver Island, 240 miles.

From Rock Creek to Vernon, to connect with the Shuswap & Okanagan, 125 miles.

From Kitimaat, on the coast to Hazleton, 100 miles.

From Fort Steele to Golden, 150 miles.

Work must be begun before July, 1902. The subsidy is not to be granted until the roads are wholly completed; the companies are to pay interest on the subsidy granted at the rate of 2 per cent. for the first five years and 3 per cent. afterwards. The government is to control passenger and freight rates, and may acquire the roads in 20 years.

CANADIAN NORTHERN.—Mackenzie, Mann & Co. have let the contract for 150 miles of new line in Manitoba to G. H. Strevel.

CAPE BRETON RAILWAY EXTENSION.—Financial arrangements are reported completed for building the entire line from the Straits of Canso, N. S., to Louisburg. (May 31, p. 373.)

CENTRAL OF GEORGIA.—Surveys are reported in progress for a line from Cuthbert, Ga., to Lumpkin, on the Seaboard Air Line, 22 miles.

CHESAPEAKE TRANSIT.—Bids for right of way have been filed for this proposed line from Norfolk, Va., to the lighthouse at Cape Henry, 16 miles. John H. Wilcox, or Norfolk, Va., is President. (Construction Supplement, March 8, 1901.)

CHESAPEAKE & OHIO.—Lane Bros. & Co. are reported to have begun building new yards below Fulton near Richmond, to be completed in about 12 months.

CHICAGO & NORTHWESTERN.—Surveys are reported in progress for an extension from Morgan, Minn., west about 45 miles via Wabasso to Marshall.

The company is said to be making preparations to build a branch from Central City, S. Dak., to Lead.

CHICAGO GREAT WESTERN.—The Iowa Railroad Commissioners have received official statement of the proposed building by this company as follows: From Clarion, Wright County, on the Mason City & Fort Dodge, to Hampton, Franklin County, terminus of the Waverly branch; from the southern terminus of the Lyle branch to Mason City, the northern terminus of the Mason City & Fort Dodge; from Fort Dodge to Omaha, and from Fort Dodge to Sioux City. (May 24, p. 357.)

CINCINNATI, OXFORD & WESTERN.—This company was incorporated in Ohio, June 15, with a capital stock of \$10,000, to build a line from Cincinnati through New Baltimore and St. Charles to Oxford, Butler County. The incorporators are: Homer Morris, J. F. Gillespie, H. H. Smith, Walter Morris, S. E. Frye and R. S. Gillespie.

CLEVELAND & EASTERN (ELECTRIC).—An officer confirms the report that the company has taken control of the Cleveland & Chagrin Falls and the Chagrin Falls & Eastern. The proposal is to extend the same east to Hiram and Garrettsville, and thence to Warren, Ohio. All arrangements have been made and contracts let. (July 7, p. 389.)

CLEVELAND, WADSWORTH & SOUTHERN.—This company has been incorporated in Ohio, with a capital stock of \$10,000, to build a railroad.

COLORADO & SOUTHERN.—According to Denver reports, official announcement has been made that the suburban lines will be operated by electricity, and that manufacturers have been asked to suggest plans and submit estimates.

COOPERSTOWN & MOHAWK VALLEY.—This company was incorporated in New York, June 16, with a capital of \$200,000, to build a road from Cooperstown to Springfield Center, Otsego County. The directors are: Edward L. Collins, Stephen Jennings, Charles H. Cogswell, B. S. Nickerson, Clarence T. Eldridge, Warren Hawn, A. Devendorf, John Gyer and A. M. Farnum.

DAYTON & FAUSDALE.—New officers have been elected and it is proposed to complete this line from Dayton, Ala., north nine miles to Faunsdale, and thence to the coal fields. The line has been graded for nine miles. The officers are given under Elections and Appointments.

DENVER & NORTHWESTERN.—This company has been incorporated in Colorado, to build a line before projected

under the Denver, Boulder & Northern. The capital stock is $2,500,000. The line is projected from Denver via Boulder and Greeley to the mouth of Platte Canyon. Samuel M. Perry, Charles J. Hughes, Jr., William G. Smith, Gerald Hughes, Frank Perry, Albert Smith and Clyde Turnbull are incorporators. (D., L. & N., May 17, p. 342.)

East Jordan & Southern.—Building is reported under way on this line from East Jordan, Mich., to Bellaire. It is reported that track is laid for about four miles from Bellaire.

Ellenville & Kingston.—The entire contract for building this line from Ellenville to Kingston, N. Y., has been let to J. M. Jackson & Co., Mitchell House, Ellenville, N. Y. Sub-contracts will be let. (April 5, p. 246.) A. E. Godeffroy, 45 Broadway, New York, is President of this company and also of the Port Jervis, Monticello & New York and the Kingston & Roundout Valley. (Official.)

Findlay, Upper Sandusky & Marion Electric.—This company has been incorporated in Ohio, with a capital stock of $10,000, to build a line about 48 miles long connecting the three cities named. The incorporators are: Ex-Lieutenant Governor Asa W. Jones and J. H. Ruhlman, of Youngstown; Hon. M. A. Smalley and C. E. Swartzbaugh, of Toledo; Judge Allen Smalley, of Upper Sandusky; William E. Scofield, of Marion; and P. B. Morrison, Hon. David Joy and Jason Blackford, of Findlay.

Florida Roads.—The Bond & Bond Co. has been incorporated at Deland, and will build a railroad from Douglas to Neoga, St. Johns County, about 40 miles. Frederick E. Bond and John B. Conrad are interested.

Fort Scott, Iola & Western.—This company has been incorporated to build the line recently referred to from Moran, on the Missouri, Kansas & Texas, to run west through Iola, Kan., to Piqua, on the same line. J. E. Henderson, of Sedalia, Mo., is interested. (May 24, p. 357.)

Frostburg, Eckhart & Cumberland (Electric).—This company and the Lonaconing, Midland & Frostburg are building a line from Cumberland, Md., to run southwest via Eckhart, Frostburg, Ocean, Borden and Midland to Lonaconing. The Pennsylvania State Construction Co., 735 Drexel Bldg., Philadelphia, has the contract for building and equipping. Three miles are graded and one mile of track is laid. John W. Burchinall is President of both companies, and James Hooten, Secretary. (Official.)

Golden Bridge Electric.—Surveys are reported completed and contracts awarded for this line from North Salem, Westchester County, N. Y., to run east to Richfield, Conn., and thence to Danbury. E. B. Brady, of Golden Bridge, and F. W. Seibert, of Waterbury, Conn., are directors. (May 24, p. 357.)

Grand Trunk.—The company proposes, according to report, to build a new line from Jordan to Niagara Falls. The grade at Napanee, Ont., is to be raised about 6 ft. for about one mile, which may require a change in the station and will cause the raising of the bridge over the Napanee River.

Great Northern.—Building is to be begun at once, according to report, on the Chuckanut Mountain cut-off from Fair Haven, Wash., south along the water front to a point near Burlington. H. C. Henry has the contract.

Greenwich & Johnsonville.—The company has decided to build an extension from Greenwich, N. Y., west across the Hudson River to Schuylerville.

Gulf & Brazos Valley.—J. H. Holt is reported to have the contract for grading from Mineral Wells, Texas, north to the Jack County line, on the extension to Jacksboro. E. B. Carver, of Mineral Wells, Texas, President and General Manager, is reported to have bought the rails. (Construction Supplement, March 8, 1901.)

Hempstead, Mineola & Freeport Traction (Electric).—The trustees of the village of Hempstead, N. Y., have granted a franchise for this line through its streets for the proposed line connecting the cities named.

Illinois Central.—Arrangements are reported made with the Penitentiary Board of Control in Mississippi, for building a spur from Parchman to the new convict farm in Sunflower County, about four miles.

Kansas City, Fort Scott & Memphis.—Amended articles of incorporation have been filed in Kansas for building a connecting link 24 miles long from Oswego to Jacques Junction, to connect with the St. Louis & San Francisco.

Kentucky Midland.—This company has been incorporated in Kentucky to build an extension of the Kentucky Western from Dixon, Ky., to Sebree, on the proposed extension to Owensboro, 40 miles. (May 24, p. 357.)

La Salle, Peru & Western.—This company has been incorporated in Illinois, with general offices at Ottawa. Thomas Wood, Jarvis R. Burrows and Charles H. Carpenter are incorporators.

Lonaconing, Midland & Frostburg (Electric).—See Frostburg, Eckhart & Cumberland.

Louisville & Nashville.—Building is reported begun on the additional track between Shepherdsville, Ky., and Lebanon Junction, 12 miles. (June 7, p. 389.)

Maine Central.—An officer is quoted as saying that building will be begun, about July 1, on the proposed line from Winthrop, Me., northeast about 13 miles to Augusta. (May 3, p. 304.)

Manitoba Roads.—Premier Roblin has announced the Government's intention of building a railroad 10 miles south from Carman this year.

Mansfield, Cardington & Delaware.—This company has been organized in Ohio to connect the cities named. A. A. Whitney is President; F. R. Case, Vice-President, and C. W. Schaaf, Secretary.

Mexican National.—Surveyors are reported locating the line for shortening the main road between the City of Mexico and San Miguel by 25 miles.

Minneapolis & Anoka.—This company has been incorporated in Minnesota, with a capital stock of $200,000, to build a steam or electric road between the cities named. The incorporators are: John J. Elliott, Arthur W. Selover, E. H. Fuller, George H. Selover and William Williamson, all of Minneapolis.

Minneapolis, St. Paul & Sault Ste. Marie.—A branch is reported under consideration about eight miles long to Star Prairie, Wis.

Missouri, Kansas & Texas.—The company is reported decided to enlarge its freight yards at Greenville, Texas, requiring about 10 miles of new track.

Mount Rogers & Eastern.—Surveys are reported in progress for this proposed line from Bristol, Va., to run east via Damascus, Independence, Floyd, Rocky Mount, Chatham, Smithville, Lunenburg and Sussex to a point on the Atlantic Coast. Col. George B. Inman, of New York, is the projector.

Moville Extension.—This company was incorporated in Iowa, June 12, with a capital stock of $10,000, to build a railroad from near Sergeant Bluff, on the Chicago & Northwestern, to run northeast 21 miles to Moville, the present terminus of the Maple River branch. Marvin Hughitt, President of the Chicago & Northwestern, and other officers of that line, are directors. The route is along a survey made 15 years ago. Most of the right of way is obtained.

Norfolk & Western.—The company is reported arranging to build a branch along the New River in Virginia to a projected cotton mill.

Pennsylvania Company.—The Pittsburgh, Fort Wayne & Chicago, according to report, has let contracts for 34 miles of second track between Bucyrus, Ohio, and Dunkirk, to Wm. Kennifik and E. H. France, of Pittsburgh. (June 7, p. 390.)

Pennsylvania Roads.—The Mayor of Philadelphia has signed the ordinances granting right of way over the city streets for the 13 companies referred to last week, whose proposed lines will cover 120 miles of street. Prior to the signing of the ordinances, John Wanamaker offered to pay the city $2,500,000 for the same franchises. It is said that Mr. Wanamaker, Albert L. Johnson and other interests will fight the matter in the courts. (June 14, p. 422.)

Pennsylvania Roads (Electric).—The Mellon Syndicate of Pittsburgh, of which Wm. J. Berriman is President, has incorporated the following companies: Shady Avenue & Homestead Street Railway; capital, $18,000. Swissvale & McClure Street Railway; capital, $18,000. Ligonier & Chestnut Bridge Street Railway; capital, $70,000. First Avenue & Ferry Street Railway; capital, $6,000. Duquesne & Oak Street Railway; capital, $21,000.

Pere Marquette.—The company has filed a map with the State Board of Railroad Crossings, showing a proposed extension of a spur to the factory of the Saginaw Sugar Co., Saginaw, Mich.

Pittsburgh & Lake Erie.—Plans are reported completed for an extension from Fayette City, Pa., to Brownsville.

Pittsburgh & Western.—The Pittsburgh, Cleveland & Toledo has amended its charter so as to build a branch at Niles, Trumbull County, Ohio.

Quebec Southern.—The company proposes to relay with 80-lb. steel its lines between Albury and Sorel, Que.

Red Fork & Shawnee Coal & Railway.—This company proposes to build from Red Fork, Ind. T., southwest about 80 miles to Shawnee, Okla. T., with a branch 15 miles long to Mounds, Ind. T. Surveys are reported begun and bonds have been authorized to the amount of $120,000. The main office is at Tulsa, Ind. T. The officers are given under Elections and Appointments.

Republic & Grand Forks.—Contracts are reported let to George S. Deeks & Co. for building 46 miles of line connecting Grand Forks, B. C., with Republic, Wash., to be completed by Nov. 1, and building is said to be in progress. (Construction Supplement, March 8, 1901.)

Southern Pacific.—Building is reported begun on the Abbeville extension from Abbeville, La., west 23 miles to Gueydan. (April 26, p. 292.)

Springfield, Jefferson City & Chicago.—Surveys are reported made for two lines between Springfield, Mo., and Jefferson City. The estimated distance is 121 miles. It is proposed to cross the Missouri at either Jefferson City, Boonville or Glasgow. Bids will be received in a few weeks for the section from Versailles, Mo., south. Wm. Woodburn, of Des Moines, Iowa, is President. (March 22, p. 210.)

St. Thomas Street (Electric).—The company has announced its willingness to extend its line to Port Stanley, Ontario.

Toledo & Indiana (Electric.)—This company has been incorporated in Ohio, to build from Toledo through Holland, Swanton, Delta, Wauseon and other points to Bryan. Among those interested are: A. K. Detwiler, George G. Metzger, of Toledo, and J. Q. Files, of Wauseon.

Wadley & Mount Vernon.—Preliminary surveys are made for the proposed extension from Douglas, Ga., to the Ocmulgee River, 15 miles. (May 24, p. 358.)

Wheeling & Lake Erie.—The company has amended its charter to permit the building of a branch from the main line in Orange Township, Ohio, to Craig's stone quarry in Minerva Township.

Wheeling & Lake Erie.—Vice-President Joseph Ramsey, Jr., of the Wabash, has authorized bids to be advertised for a bridge across the Monongahela River, and for 12 miles of road south from Bridgeville, on the proposed Pittsburgh & Carnegie extension into Pittsburgh. The work must be completed by Nov. 1, 1902. (May 10, p. 324.)

White Pass & Yukon.—Application has been made to the Dominion Parliament for a charter for a railroad from a point on this line to Rainy Hollow and Porcupine Creek, B. C., with power to sell or lease to or amalgamate with the White Pass & Yukon. Benjamin Russell, K. C., of Halifax, is the solicitor.

RAILROAD NEWS.

Baltimore & Ohio.—The Maryland Court of Appeals, on June 13, affirmed the decision of the lower state courts, holding that the preferred stock of the company is limited to 4 per cent. dividends, and that all surplus earnings above that amount, so far as distributed by the directors, belong entirely to the common shares.

Chicago Great Western.—Application has been made to the New York Stock Exchange to list $2,000,000 additional 4 per cent. debenture B stock, and $2,500,000 additional 4 per cent. debenture stock.

Cincinnati & Cleveland.—The stockholders will vote to increase the capital stock from $15,000 to $2,000,000. The road is projected from Cincinnati, Ohio, northeast to Cleveland, with branches from Cummingsville near Cincinnati, to Westwood, Harrison, Philanthropy and Hamilton. Powell Crosley, 420 Pike Bldg., Cincinnati, is President. (Construction Supplement, March 8, 1901.)

Cincinnati Northwestern.—This line, running from College Hill Junction, Ohio, to Mt. Healthy, seven miles, has been sold to ex-Judge C. D. Robertson.

Detroit Southern.—It is said that the injunction granted last week to restrain the reorganization committee from disposing of the property of the Detroit & Lima Northern recently made, will have no effect upon the organization of the successor company, the Detroit Southern, as the property has been turned over to that company. A temporary certificate for common stock to which the Detroit & Lima Northern may be entitled has been delivered to the Colonial Trust Co. (D. & L. N., June 14, p. 422.)

Grand Rapids, Grand Haven & Muskegon.—The Security Investment Co., of Pittsburgh, and others are receiving subscriptions at 102½ for $1,250,000 of this company's first mortgage 5 per cent. 25-year gold bonds, due July 1, 1926, the issue being limited to $1,500,000. This is an electric line now building between Grand Rapids, Mich., Spring Lake, Grand Haven and Muskegon. (Dec. 21, 1900, p. 852.)

Great Falls & Canada.—A meeting of the stockholders has been called to ratify the sale of this property to the Great Northern. The line runs from Great Falls, Mont., to Sweetgrass, 134 miles, where it connects with the Alberta Railway & Coal Company's line, which extends on north 64½ miles to Lethbridge, Alberta.

Herkimer, Mohawk, Ilion & Frankfort Street (Electric).—This property has been sold to the Everett-Moore syndicate of Cleveland, which controls extensive electric roads between that city and Detroit, Mich.

Missouri Pacific.—The directors, on June 17, resumed the payment of dividends by declaring a 2½ per cent. semi-annual dividend on July 20, to stockholders of record July 5. The last dividend was paid in 1891, being 3 per cent.

A resolution was also passed authorizing the issue of new stock to the amount of 15 per cent. of the present holdings of stockholders. Stockholders may subscribe at par. (June 14, p. 422.)

Muskegon, Grand Rapids & Indiana (Pennsylvania Co.).—The first mortgage coupon No. 26, due July 1, 1899, is now being paid through Winslow, Lanier & Co.

Newfoundland.—Under the agreement with Robert G. Reid, practically owner of this line, Mr. Reid agrees to surrender the telegraphs to the Government and to revise his land grants so that the rights of other holders will be protected. He will permit the Colony to buy from him the ownership of the railroad after 50 years, provided the Government will agree to the transfer of the property to a limited liability company. (May 21, p. 374.)

Northern Central.—The company has declared a semi-annual dividend of 4 per cent., which is an increase of 1 per cent. over the same period of last year, and places the stock on an 8 per cent. basis.

Philadelphia & Reading.—The stockholders of the Atlantic City, the Camden County and the Seacoast have taken final action for merging these properties into the Atlantic City. All the companies are controlled by the P. & R. (May 31, p. 374.)

Pittsburgh & Western.—In the U. S. Circuit Court at Pittsburgh, June 17, John K. Cowen resigned as receiver and L. F. Loree, President of the Baltimore & Ohio, was appointed his successor by Judge Acheson.

Pittsburgh, Fort Wayne & Chicago.—Francis T. White, of New York, owner of 200 shares of the 7 per cent. special guaranteed stock, has brought suit in the U. S. Circuit Court at Pittsburgh, to enjoin the directors from paying the extra 2 per cent. dividend on the original guaranteed stock, unless the same dividend is paid on the special guaranteed stock. (May 3, p. 308.)

Pittsburgh, Painesville & Fairport.—Holders of the Mercantile Trust Company's certificates for first mortgage bonds and first mortgage terminal bonds are notified by the reorganization committee that a proposition has been made to buy the bonds at $1,129.10 for each $1,000 bond, or 105.41 for the principal and 7½ per cent. for the accrued interest to July 1, to holders who surrender their certificates on that date to the Mercantile Trust Co. (Aug. 17, 1900, p. 560.)

Portland & Rumford Falls.—The company has increased its quarterly dividend to 1½ per cent. The last dividend of 1 per cent. was paid Dec. 15 last.

Rio Grande Western.—Kuhn, Loeb & Co., and Spencer Trask & Co., offer a block of the first consolidated 4 per cent. 50-year gold bonds at 96. These bonds are secured by a first mortgage, either directly on railroad branches or on all other securities on 173 miles of railroad in operation, and further by a mortgage on 438 miles of main line and other road, and all other existing property of the company, subject to a prior lien of $15,200,000 first mortgage 4 per cent. bonds. (April 5, p. 246.)

St. Louis & San Francisco.—The stockholders, on June 15, authorized an increase of the capital stock from $50,000,000 to $100,000,000. Of this increase $15,000,000 is to be second preferred, and $35,000,000 common stock. There is an increase authorized of the bonded indebtedness of $85,000,000. The stockholders also agreed to the purchase of the Arkansas & Oklahoma, the Central Oklahoma & Southern and the Oklahoma City Terminal, all auxiliary lines of the parent company. (April 12, p. 260.)

Shreveport & Red River Valley.—The company recently filed a mortgage to the Farmers' Loan & Trust Co., trustee, to secure an issue of 4 per cent. gold bonds due 1950. Upon the line in operation from Shreveport, La., to St. Maurice, 76 miles, $1,520,000 has been issued and the company is empowered to issue $940,000 on the 42 miles from St. Maurice to Pineville. It is stated that the company is further authorized to issue $300,000 for a bridge over the Red River at Alexandria, and a further issue of $20,000 per mile of completed road to the Mississippi River and thence to New Orleans.

South Bound.—Chief Justice McIver, of the South Carolina Supreme Court, at Cheraw, on June 11, granted an order staying the appointment of a receiver pending the appeal to that court. The property is to be consolidated with the Seaboard Air Line. (June 14, p. 422.)

Toledo Traction (Electric).—The Everett-Moore syndicate of Cleveland is reported to have obtained control of this line in and about Toledo in connection with its proposed system from Cleveland to Detroit.

Velasco Terminal.—The sale of this property to Harris Masterson, of Houston, Texas, for $28,500, made May 7, has been confirmed at Galveston by District Judge Wells Thompson. (May 17, p. 342.)

Wiscasset, Waterville & Farmington.—At a meeting of the directors and stockholders of the Franklin, Somerset & Kennebec and the Waterville & Week's Mills, the property and stock of these companies were transferred to the Wiscasset, Waterville & Farmington, which was recently incorporated under a special law in Maine to take over the property. (April 19, p. 276; Waterville & Farmington, April 5, p. 246.)